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Contributions of Urban Roadway Usage to Water Pollution

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CONTRIBUTIONS OF URBAN ROADWAY USAGE TO WATER POLLUTION

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ABSTRACT

Street surface contaminants are deposited on roadways from many sources within an urban area. Industrial operations, land use activities, fallout of air pollutants, roadway usage and other activities contribute to the loading of particulates on urban roadways. These materials are then carried into receiving waters by storm runoff where they constitute a substantial portion of the overall water pollution problems of cities. Metropolitan Washington, D.C., with its low background of industrial emissions, was the area chosen for study of contributions of motor vehicle usage to urban roadway loading factors. Specific roadway study sites within this area were selected so as to provide minimal interference from nontraffic-related land use activities and thus isolate, as much as possible, the traffic-related depositions.

Motor vehicular traffic is directly or indirectly responsible for deposition of substantial quantities of materials on roadways in urban areas. Significant levels of toxic heavy metals and asbestos and slowly biodegradable petroleum products and rubber are deposited directly from motor vehicles along with large quantities of particulate materials contributed indirectly by traffic. The particulates contributed indirectly by traffic are largely inorganic, but have associated with them solids and nutrients which represent a serious source of water pollutants in all metropolitan areas.

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SECTION I

CONCLUSIONS

CONTRIBUTIONS OF MOTOR VEHICLES TO WATER POLLUTION IN URBAN AREAS

Traffic dependent rates of deposition of street surface contaminants have been determined as part of this study and are given in Table 1 along with the percentage composition of materials being deposited through traffic-related mechanisms. In general these percentages will not strictly be representative of materials found on streets throughout all urban areas because many roadways receive substantial deposition of differing composition from land use activities other than transportation. Some of the more hazardous constituents of street contaminants originate directly from the motor vehicle. Most of the bulk of deposited roadway materials are representative of the local geology and a lesser amount originates with the street surface material itself. However, all materials being deposited at rates given in Table 1 are attributable to traffic and would not be present were it not for the passage of motor vehicles. Contributions from nontraffic-related sources were eliminated, to the extent possible, in the determination of these rates.

Dependency of the composition of traffic-related street surface contaminants upon local geology will give rise to some geographic variations in the deposition rates listed in Table 1 which were developed from samples taken in the Washington, D.C. Metropolitan area. However, it is believed that most of the rates will be rather uniformly applicable. Greatest variations will be found in rates of deposition of volatile solids, BOD, COD, phosphorus, nitrogen, chloride and the magnetic fraction. Additionally, other pollutants not listed here may appear to be traffic-related in certain metropolitan areas of the country, depending upon their presence in area soils.

In addition to the traffic-related materials, other street surface contaminants are deposited on urban roadways through mechanisms unrelated to motor vehicular traffic. Litter, defined as particles larger than 3.35 mm, pollutants associated with litter, fecal coliform and fecal streptococcus organisms, polychlorinated biphenyls and small amounts of cadmium also appear along roadway surfaces. No dependency upon traffic could be shown for these pollutants. Further, no cyanide or hexavalent chromium were found in any of the roadway deposits tested.

SOURCES OF TRAFFIC-RELATED STREET SURFACE CONTAMINANTS

Street surface contaminants are deposited on roadways via mechanisms which may be related, or unrelated, to traffic. Loadings of the related depositions will be proportional to total traffic and may arise directly (tire rubber, motor oil) or indirectly (abraded materials from roadway surfaces) from the motor vehicle. The bulk of traffic-related materials

TABLE 1. DEPOSITION RATES AND COMPOSITION OF TRAFFIC-RELATED ROADWAY DEPOSITS[a] (WASHINGTON, D.C. METROPOLITAN AREA)

Parameter	Dust and Dirt Deposition Rates (Units -- Unless Otherwise Stated) lbs/axle-mile	Dust and Dirt Deposition Rates (Units -- Unless Otherwise Stated) g/axle-km	Composition (% by Weight Unless Otherwise Stated)
Dry Weight	2.38×10^{-3}	6.71×10^{-1}	-
Volume	6.33×10^{-4} (quarts/axle-mile)	4.33 (l/axle-km)	-
Volatile Solids	1.21×10^{-4}	3.41×10^{-2}	5.1
BOD	5.43×10^{-6}	1.53×10^{-3}	0.23
COD	1.28×10^{-4}	3.61×10^{-2}	5.4
Grease	1.52×10^{-5}	4.29×10^{-3}	0.64
Total Phosphate-P	1.44×10^{-6}	4.06×10^{-4}	0.061
Nitrate-N	1.89×10^{-7}	5.33×10^{-5}	0.0079
Nitrite-N	2.26×10^{-8}	6.37×10^{-6}	0.00095
Kjeldahl-N	3.72×10^{-7}	1.05×10^{-4}	0.016
Chloride	2.20×10^{-6}	6.20×10^{-4}	0.092
Petroleum	8.52×10^{-6}	2.40×10^{-3}	0.36
n-Paraffins	5.99×10^{-6}	1.69×10^{-3}	0.25
Asbestos	$3.86 \times 10^{+5}$ (fibers/axle-mile)	$2.40 \times 10^{+5}$ (fibers/axle-km)	3.6×10^{5} (fibers/gram)
Rubber	1.24×10^{-5}	3.50×10^{-3}	0.52
Lead	2.79×10^{-5}	7.87×10^{-3}	1.2
Chromium	1.85×10^{-7}	5.22×10^{-5}	0.008
Copper	2.84×10^{-7}	8.01×10^{-5}	0.012
Nickel	4.40×10^{-7}	1.24×10^{-4}	0.019
Zinc	3.50×10^{-6}	9.87×10^{-4}	0.15
Magnetic Fraction	1.26×10^{-4}	3.55×10^{-2}	5.3

(a) Numerous other pollutants were found in urban roadway samples; however, those listed in the table were the only ones related to motor vehicular traffic.

deposited on roadways do not originate directly from the motor vehicle. Much of the traffic-related street surface contaminants are representative of local geology and, to a lesser extent, products abraded from the roadway surfaces and are largely inorganic. Carbonates constitute a major portion of the volatile solids found in samples from the Washington, D.C. Metropolitan area. The analysis of "pure" materials shown in Table 21 was performed to aid in establishing the origin of pollutants found in roadway deposits. Most of the traffic-related BOD, COD, magnetic fraction, chloride, nitrogen, volatile solids and phosphorus arise from sources other than the motor vehicle itself. Phosphorus and chloride are most likely derived from area soils and roadway surface abrasion. The winter during which this study was conducted was extremely mild and very little salt was applied to area roadways indicating that the chloride levels found are not from deicing compounds. The low levels of traffic-related nitrogen found were contributed by soils and plant materials carried onto the roadway by motor vehicles.

Less than 5% by weight of the traffic-related deposits originate directly from motor vehicles; however, these pollutants are among the most important by virtue of their potential toxicity.

- Much of the grease and all of the petroleum and n-paraffins result from spills or leaks of motor vehicle lubricants, antifreeze and hydraulic fluids.

- Traffic-related lead is deposited principally through the use of leaded fuels; however, some results from the wear of tires in which lead oxide is used as filler material.

- Zinc is also used as a filler in tires and at high concentrations in motor oil as a stabilizing additive.

- Copper, nickel and chromium are wear metals from metal plating, bearings, bushings, and other moving parts within the engine. Considerable copper is deposited as a result of wear of brake linings which have copper added to increase mechanical strength and promote more rapid dissipation of heat.

- As reported in recent studies of motor vehicle operations, asbestos arises from wear of clutch and brake linings (1) and tire wear is the source of traffic-related rubber found in roadway deposits (2).

SIGNIFICANCE OF RUNOFF OF TRAFFIC-RELATED DEPOSITIONS TO URBAN WATER POLLUTION

It was concluded in the Literature Review on Urban Runoff prepared for this study, see Appendix H, that urban stormwater runoff is frequently a significant portion of the total pollution entering area receiving waters on a yearly basis, and is always significant on a shock-load basis as is encountered during periods of runoff. The data in Table 2 have been calculated and compiled to demonstrate the significance of that portion of total urban stormwater runoff pollution from traffic-related sources. This has been done by determining the per capita amounts of pollutants which would enter receiving waters each day from traffic-related depositions and from final effluent of a good secondary sewage treatment plant, assuming uniform flow rates. On a population adjusted basis, runoff of traffic-related roadway deposits represent about 75% of the total suspended solids from traffic and sewage treatment plant final effluent and 15% of the total COD. With the exception of heavy metals and asbestos, the other contributions of traffic to urban water are not as significant when uniform flow is assumed. Traffic-related heavy metals constitute the most serious contaminant from this source when compared with sewage. For example, close to 100% of the lead entering urban receiving water is from traffic-related sources. The situation becomes much more serious when considered on a shock-load basis which occurs during runoff events. Hypothetically, if a three-day accumulation of traffic-related roadway materials were flushed into receiving waters during the course of a two-hour runoff event, the rates of traffic-related runoff given in Table 2 would be uniformly increased by a factor of 36 (three days · 24 hrs./day ÷ two-hr. runoff). Impact ratios given in Table 2 demonstrate the increased contributions of traffic-related roadway depositions, relative to final effluent, during a runoff event. Traffic-related deposits by themselves would then constitute a significant source of pollution on a shock load basis for each parameter listed; thus, the importance of traffic contributions to urban water pollution is established. Potentially the most serious emission quantitated by this study is the traffic-related asbestos deposited on roadways and discharged as an air pollutant. Asbestos emissions from motor vehicles probably constitute a major source of total population exposure in many urban areas (3).

VARIABLES AFFECTING DEPOSITION OF STREET SURFACE CONTAMINANTS

The principal program objectives of investigations of traffic-related water pollution necessitated certain sacrifices in the study of other factors contributing to the total urban runoff situation. For example, little can be said concerning contributions from other land use activities except that shopping centers and roadways near heavy construction activities receive deposits considerably in excess of amounts which would be predicted on the basis of traffic intensity alone. The roadway deposits at the one shopping center studied averaged about 12 times higher (8.10 kg per axle-kilometer) than would have been predicted on the basis of traffic volume alone. Likewise, a roadway across the street from a construction site received nearly 14 times (9.2 kg per axle-kilometer) the expected amount of deposited materials. However, it was possible to draw a number of important conclusions relative to variations in deposition rates of traffic-related materials since most of the roadway sites studied received deposits principally from this source.

TABLE 2. SIGNIFICANCE OF RUNOFF FROM TRAFFIC-RELATED ROADWAY DEPOSITS TO URBAN WATER POLLUTION (COMPARISON WITH SECONDARY SEWAGE TREATMENT PLANT EFFLUENT)

Parameter	Sewage Composition[a]		Average Per Capita Mass Flow Rates		
	Raw (mg/l)	Final Effluent (mg/l)	Final Effluent[b] (g/cap-day)	Traffic-Related Depositions[c] (g/cap-day)	Traffic[d] Impact Ratio (Traffic/Effluent)
Suspended Solids	235	24	9.08	26.3	104
BOD	140	14	5.30	0.06	0.41
COD	200	20	7.57	1.41	6.7
Kjeldahl-N	30	3	1.14	0.004	0.13
Phosphate-P	10	7	2.64	0.016	0.22
Lead	-	0.03	0.011	0.31	1015
Zinc	-	0.08	0.030	0.039	47
Copper	-	0.03	0.011	0.003	9.8
Nickel	-	0.01	0.004	0.005	45
Chromium	-	0.01	0.004	0.002	18

(a) Estimates of raw sewage and final effluent concentrations are for separate domestic sewage and have been derived from Fair and Geyer (4), EPA's manual on phosphorus removal (5) and a recent publication on elemental analysis of wastewater sludges (6).

(b) Average per capita flow rates of pollutants in final effluent have been calculated assuming a per capita flow of 100 gallons of sewage per day.

(c) Average per capita depositions of traffic-related pollutants available in urban stormwater runoff have been calculated assuming a per capita driving distance of 24.3 axle-miles per day and deposition rates of traffic-related pollutants given in Table 1. The per capita driving distance was derived from 1968 figures of 66 x 10^6 axle-miles per day from a population of 2,714,000 in the Washington, D.C. Metropolitan area (7). For example:

$$\frac{5.43 \times 10^{-6} \text{ lbs. BOD}}{\text{axle-mi.}} \cdot \frac{24.3 \text{ axle-mi.}}{\text{cap.-day}} \cdot \frac{454 \text{ g}}{\text{lb.}} = 0.060 \text{ grams/capita-day}$$

(d) Runoff, during a two-hour storm event, of traffic-related materials deposited on roadways over a three-day period has been compared with sewage final effluent discharged to receiving waters during this same two-hour storm.

One important observation was the effect of curb height upon the amount of material collected from the roadway. Figure 1 shows average per axle dry weight loadings for litter (particles larger than 3.35 mm) and dust and dirt (particles smaller than 3.35 mm) collected at the roadway sites as a function of height of the curb or roadway barrier along which the samples were collected. As might be expected, accumulation of the larger litter particles was not markedly affected. Inspection of this figure reveals that per axle dust and dirt loadings increased with curb height up to about 15 to 20 inches. These data indicate that considerable quantities of the smaller sized dust and dirt particles become airborne and are carried over curbs to settle on areas adjacent to the roadways. This effect of barrier height upon the dry weight of sample collected represents a significant finding in terms of the consequences of street and highway construction.

Some marked seasonal variations were noted in the magnitude of certain components of street surface materials as shown in Tables 3 and 4. Depositions of litter and dust and dirt were fairly uniform throughout the year while fecal coliforms and fecal streptococci were found to be much higher during summer and fall seasons. Volatile solids, BOD and COD depositions were generally higher in summer and fall. This is probably related to the greater amounts of plant materials which occur during these seasons. Grease deposits were uniform as would be predicted if the majority of this substance were a direct result of motor vehicle usage. Lead, zinc and rubber were found to be considerably higher during warm seasons while the other heavy metals were deposited at relatively uniform rates throughout the year. This is probably attributable to a greater rate of tire wear at the higher ambient temperatures.

TABLE 3. SUMMARY OF SEASONAL VARIATIONS IN LOADING OF NONTRAFFIC-RELATED POLLUTANTS ON ROADWAYS[(a)]

	Average 24 hr. Accumulation			
Pollutant (Units)	Winter	Spring	Summer	Fall
Litter (kg/km)	14.3	24.5	24.8	14.9
Fecal Coliforms (million org./km)	17.5	2.9	545.3	60.9
Fecal Streptococci (million org./km)	25.4	25.1	330.0	83.5

(a) Data given are average seasonal loadings calculated from samples with one-day accumulation periods taken at sites which were sampled throughout the year.

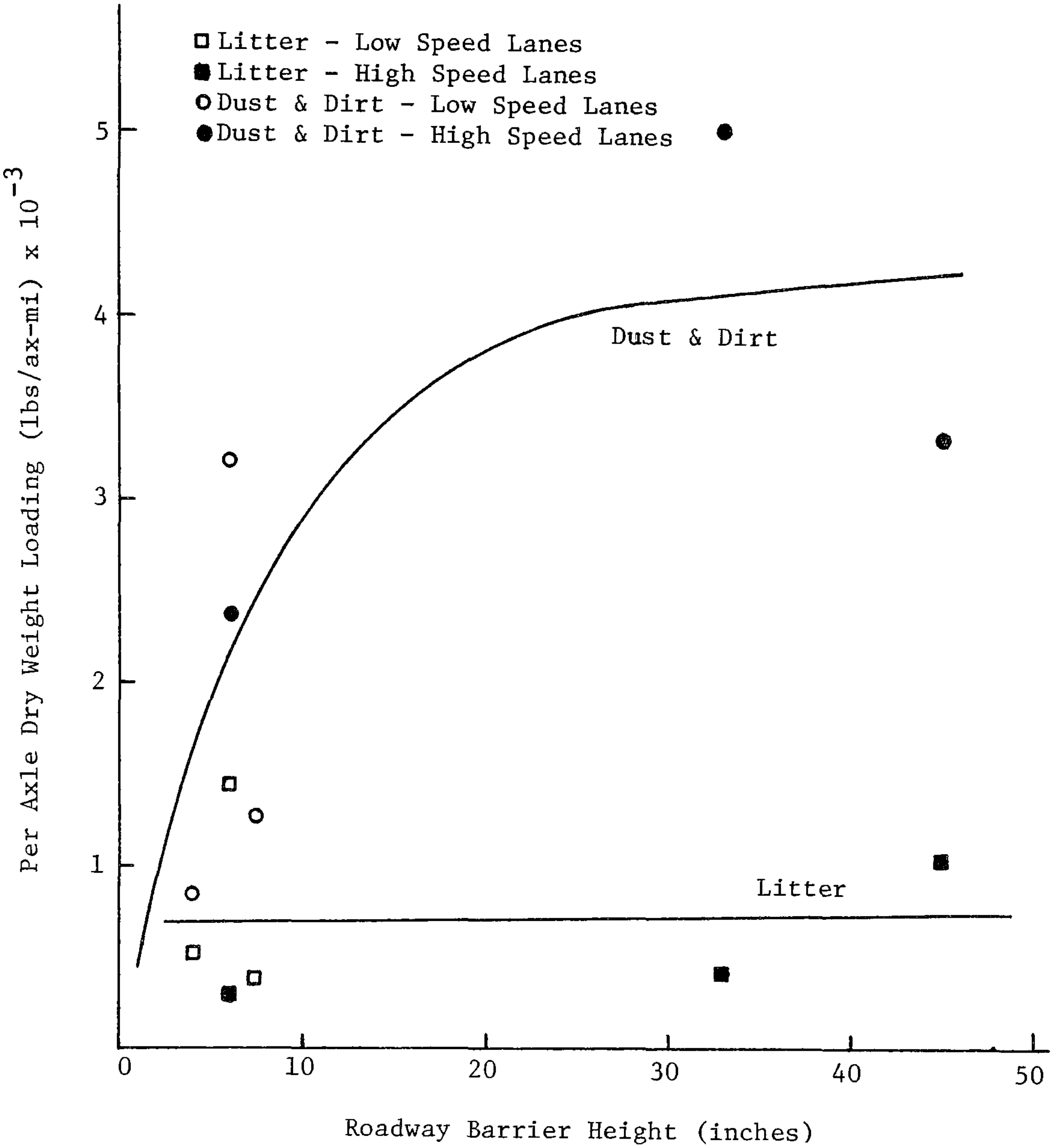

Figure 1. Per axle dry weight loading vs. roadway barrier height[a]

(a) Average per axle amounts of litter and total dust and dirt dry weight collected at each of the sites receiving principally traffic-related deposits have been plotted versus height of the curb or other roadway barrier against which samples were collected.

No apparent effect on depositions of street surface contaminants was discernible due to speed, traffic mix or composition of the roadway paving material. This is not to say that such effects do not exist, but rather that their influences were too subtle to be detected. The random nature of the deposition of street surface contaminants made it difficult to detect subtle influences. Deposition rates of litter and dust and dirt dry weight were found to have a relative standard deviation of about 25%.

TABLE 4. SUMMARY OF SEASONAL VARIATIONS IN LOADING RATES OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS [(a)]

Pollutant		Average Seasonal Loading Rates (g/axle-km)			
		Winter	Spring	Summer	Fall
Dust and Dirt	($\times 10^{-3}$)	2.68	1.95	2.91	2.82
Volatile Solids	($\times 10^{-3}$)	0.14	0.11	0.18	0.25
BOD	($\times 10^{-3}$)	7.7	7.3	6.8	19.2
COD	($\times 10^{-3}$)	224	176	283	440
Grease	($\times 10^{-3}$)	29	24	33	41
Lead	($\times 10^{-3}$)	4.4	4.1	11.0	8.5
Zinc	($\times 10^{-3}$)	1.0	0.9	2.9	2.1
Rubber	($\times 10^{-3}$)	2.9	1.2	6.2	4.1

ACCUMULATION OF MATERIALS DEPOSITED ON ROADWAYS

Deposition of materials onto roadways occurs at a constant rate under a given set of conditions. That is, traffic-related pollutants are deposited at the fixed rates given in Table 1 and it appears that non-traffic-related pollutants such as litter are deposited at a rate linear with time. Although deposition is uniform, it has been found that the materials do not accumulate on roadways at a linear rate. This was determined by study of samples collected over deposition/accumulation periods of from one to four days. Data thus acquired revealed that accumulated loads had begun to level off substantially after several days. Average ratios of loadings found after a three-day accumulation period divided by those found after a one-day accumulation period are given for selected pollutants in Table 5. The observed ratios would be approximately three if accumulation rates were linear. These values are all significantly lower than three which substantiates this decrease in rate of accumulation of roadway materials.

(a) Data given are average seasonal loading rates calculated from samples taken at sites which were sampled throughout the year. Loading rates are to be multiplied by the power of ten shown in parentheses beside each pollutant. For example, a tabulated BOD 7.7 equals 7.7×10^{-3} g/axle-km.

TABLE 5. COMPARISON OF ROADWAY LOADINGS OF TRAFFIC-RELATED MATERIALS FROM SAMPLES WITH ONE-DAY AND THREE-DAY DEPOSITION/ACCUMULATION PERIODS

Parameter	Average Curb Loading Ratios[(a)] (3-Day Loading/1-Day Loading)
Dust and Dirt	1.43
Chloride	1.34
Grease	1.42
Kjeldahl-N	0.91
Lead	1.21

PRACTICAL LIMITATIONS ON EFFICIENCY OF ADVANCED STREET CLEANING METHODS

A sampling procedure was developed for the collection of materials deposited on roadways which utilized a manual vacuuming followed by separate collection of a water flush of the street surface. Evaluations of the sampling method showed that essentially quantitative recoveries of particulate materials could be attained by careful vacuuming of the roadways. However, separate analyses of the particulate and flush fractions of roadway samples showed that some pollutants, particularly water soluble components present at low concentrations, were not collected at high efficiencies by the vacuuming operation alone. The data in Table 6 presents average levels recovered with the flush fraction for each pollutant. This has strong implications as to the practical limitations on the street cleaning efficiency which can be realized by advanced equipment employing sweeping and/or vacuuming of lightly loaded roadways. Thus, Thus, while it may be possible for such equipment to collect well over 90% of roadway particulates, only about 65% of the BOD will be removed from streets holding from one to three days of accumulated deposits.

INFLUENCE OF STORMWATER RUNOFF ON URBAN RECEIVING WATERS

Runoff from urban roadways induces shock effects upon receiving waters as the accumulated nutrients, toxic and oxygen demanding substances are abruptly introduced during storm events. Such events will occur several times over the course of a year and permanent changes in the downstream biota may result even though the chemical composition of the receiving water reverts to normal shortly after cessation of runoff. Chemical examinations of stream bottom samples taken from upstream and downstream of roadway runoff outfalls demonstrated that a permanent, dry weather

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(a) Ratios given are overall averages of curb loadings observed after a three-day accumulation period divided by loadings found after a one-day accumulation period. Ratios would be equal to three if accumulation of roadway materials was linear. Note that the balance of the unaccounted for materials is still available for runoff pollution as they have been merely translocated to areas adjacent to the roadway.

sphere of influence exists near the roadway/receiving water interface. The length of stream permanently influenced by the roadway was defined by maxima in concentrations of certain pollutants in bottom samples. However, it was not always possible to detect the stream area influenced in urban areas. The effects of roadway runoff on bottom samples were masked in some urban streams by the introduction of pollutants from other, principally industrial, sources.

TABLE 6. DISTRIBUTION OF POLLUTANTS BETWEEN DUST AND DIRT AND FLUSH SAMPLE FRACTIONS

Parameters	Average % of Total Pollutant Found in Flush	% Standard Deviation
Dry Weight	7	8
Volatile Solids	20	13
BOD	36	22
COD	16	12
Grease	19	15
Petroleum	19	13
n-Paraffins	19	14
Total PO_4-P	15	15
PO_4-P	43	42
NO_3-N	69	24
NO_2-N	97	7
Total Kjeldahl-N	33	23
Chloride	43	33
Asbestos	13	31
Fecal Coliforms	76	40
Fecal Strep	44	39
Lead	4	2
Chromium	17	15
Copper	5	4
Nickel	5	2
Zinc	2	1

Sampling and analysis of stormwater runoff from roadways showed the first flush effect with levels of pollutants generally decreasing during the later courses of the runoff events to a lower, but still significant, level. Sudden increases in rainfall intensity during a storm event resulted in a second peak in runoff concentrations. Zinc compounds deposited on roadways were found to be more soluble than those of lead as evidenced by the higher dissolved zinc concentrations found in the runoff samples. It is believed that this higher solubility causes zinc to be removed from roadways by stormwater runoff at a faster rate than the lead compounds.

SECTION II

RECOMMENDATIONS

GENERAL

One of the objectives of this study has been to develop practical recommendations to reduce or eliminate contributions of motor vehicular traffic to urban roadway runoff pollution. These recommendations will require expenditures of considerable sums of money and resources. However, this effort is essential if water quality in urban areas is to be maintained or upgraded.

The recommendations may be categorized as falling into the areas of urban roadway design standards and practice, advanced public works practices, motor vehicle design and future studies required to advance the state of the knowledge in this area or to more fully develop roadway runoff pollution control and abatement techniques. As background against which recommendations are viewed, the deposition of roadway materials and subsequent transport to urban rivers and streams are reviewed briefly. Roadways act as effective collectors of particulate materials deposited directly by motor vehicles, by fallout of air pollutants, wear and abrasion of roadway surfaces, intentional and accidental littering, by various land use activities and, most importantly, by collection of particulate materials which are representative of the local geology. These depositions are then carried off during runoff events into urban receiving waters. Just as roadways are efficient collectors of materials, they are also extremely effective in transporting them by virtue of their high runoff coefficients. However, even without reduction of the amounts of materials deposited on urban roadways, it is possible to effect considerable improvements in the water quality situation by altering the kinetics of transport so that peak runoff rates are delayed or flattened out over a longer period of time in order to reduce shock loads on the receiving waters. The ensuing recommendations will deal with control techniques operating at several points in the overall roadway water pollution deposition and transport mechanisms.

ROADWAY DESIGN AND CONSTRUCTION

Roadway Site Selection

Although there is only a modicum of flexibility allowed in the selection of roadway sites in urban areas, these should be chosen in such a manner as to minimize the roadway areas drained directly into the receiving body of water.

Curbing and Roadway Dividers

Curbs and roadway dividers act as efficient barriers against which almost all of the deposited roadway materials collect. This study has shown that amounts of dust and dirt which collect against a roadway barrier increased substantially with the height of the barrier.

Advantage may be taken of this phenomenon in instances where the roadway is adjacent to an unpaved area which is relatively flat or sloping away from the street surface. For example, the Baltimore-Washington Parkway site which was studied under this contract has a curb height of only four inches along the low-speed lane. This roadway does not require routine street sweeping as passing traffic blows most of the deposited dust and dirt over the low curb onto the gravel and grass areas along the roadway. During runoff events, this dust and dirt is then carried to receiving waters at a much lower rate and efficiency as compared to materials on the roadway.

Conversely, it could be advantageious to utilize the increased particulate collection efficiency of higher barriers in conjunction with the use of some form of roadway surface cleaning or runoff purification system, particularly at roadway areas draining directly into the receiving waters.

Porous Pavement

The use of porous pavement for roadway construction has been under development for a number of years. This has the effect of slowing the rate of runoff. Development of these types of pavements appears promising as a tool in combatting this form of water pollution. Studies of porous pavement should be continued to include determination of its applicability in areas having clay or other impervious type soils and colder climates.

PUBLIC WORKS PRACTICES

Street Cleaning Operations

Current street cleaning practices have estimated efficiencies which range from about 35 to 65% for dust and dirt removal based upon *in situ* street cleaning tests. Thus, it appears practical to reduce urban roadway runoff effects by intensifying present street cleaning operations. Management of urban street cleaning operations will be extremely important if maximum benefits are to be obtained and should begin with the proper training and instruction of equipment operators. With completion of the present study, sufficient data are now available to allow for the prediction of roadway materials accumulation rates taking into account both land use factors and daily traffic flows. An urban street sweeping plan should be devised which takes into consideration such factors as buildup rates and local precipitation patterns as well as special activities areas, i.e. construction sites and hauling operations, which may exist in the urban area. Maintenance of street surfaces will be required to ensure high sweeper collection efficiencies and to prevent localized buildup of particulate pollutants on roadways. Off-street and/or alternate side of the street parking regulations will be necessary to allow free access for street sweepers.

Most street cleaning equipment in use today has lower collection efficiencies for the smaller, more highly polluted dust and dirt particles. In addition, collection efficiency tends to fall off somewhat as the street loadings decrease. Since roadways will be swept more frequently and thus swept at lower dust and dirt loadings under an intensified street cleaning program, the evaluation of more efficient, advanced street cleaning equipment is recommended. Specifically, the evaluation of the more efficient vacuum street cleaners is recommended. These hold the promise of having less drop off in efficiency at lower dust and dirt loadings and particulate sizes.

Estimates of the benefits to urban area water quality resulting from an intensified street cleaning program and/or the use of advanced street cleaning equipment should be obtained from pilot studies prior to initiation of widespread use. It is recommended that evaluation of an intensified street cleaning program be implemented with the assistance of Federal funds, in a metropolitan area. Whether or not the street cleaning program utilizes advanced street cleaning equipment, these sweepers should be evaluated to determine the overall efficiency and their efficiencies as a function of dust and dirt loadings and particle size. Much of this latter type of evaluation must, of necessity, be carried out under controlled conditions on test areas of urban streets using naturally occurring and "synthetic" dust and dirt.

Special Curb/Gutter Design

Previous studies have shown that over 95% of the solids which accumulate on urban roadways are found within 40 inches of the curb (8). It may be feasible, through the use of special recessed gutters near the curb, to further concentrate all or most of this particulate material. This would allow for faster and more efficient removal of dust and dirt whether by vacuum street cleaning or street flushing techniques. It is recommended that gutter configuration be designed for this purpose and evaluated. Regular removal of deposited dust and dirt will be required as this system will transport roadway materials into receiving waters at even faster rates and with greater efficiency than conventional streets during periods of stormwater runoff.

Detention and storage of stormwater runoff, perhaps in series with ultra high rate filtration facilities offers considerable promise in the handling of urban runoff pollution. It is recommended that pilot demonstrations of these concepts be evaluated and the results analyzed in order to predict the benefits of incorporating these methods into an urban runoff pollution control plan.

Swirl Separator/Concentrator Devices

Another new concept for the handling of urban stormwater runoff is based upon use of swirl forces for solids separation. At present, there are two devices under test which utilize these forces to separate solids into concentrated side stream flows. The concentrated flow is then routed to a treatment plant and the overflow stormwater discharged to receiving waters. It is recommended that development and testing of the Swirl Concentrator and Helical Flow Regulator/Concentrator be accelerated. Evaluations of their treatment efficiencies in terms of a broad spectrum of pollution parameters, including solids, should be conducted.

MOTOR VEHICLE USAGE

Elimination of Specific Toxic Materials

As has been stated previously, the bulk of the traffic-related materials deposited on roadways do not originate from the automobile itself and, therefore, are not subject to control through changes in motor vehicle design. However, design changes to control emissions or eliminate the use of specific toxic elements disseminated by motor vehicles, especially where those toxicants are consumable items such as gasoline, brake and clutch linings and tires may be a practical means for reducing the most important toxic hazards associated with roadway materials.

Considerable quantities of traffic-related lead have been identified in street surface deposits by this current research. Lead has also been shown in intrude on the human environment by vehicular emissions of its compounds as air pollutants. Sufficient technology presently exists for elimination of lead antiknock additives in motor vehicle fuels and a program to greatly reduce lead emissions has already been instituted. It is recommended that this nationwide program be accelerated and expanded to include elimination of other organometallic gasoline additives such as those based on boron and phosphorus.

Zinc is the second most prevalent traffic-dependent heavy metal found in roadway materials. It is deposited at a rate about one-eighth that of lead. Although zinc is generally considered to be much less toxic than lead, it occurs on roadways in a very soluble form and is, therefore, difficult to remove from runoff and readily transported by the receiving waters. Considerable quantities of zinc oxide and other inorganics are frequently used as fillers in tires. It is recommended that a product be developed and tested which substitutes such relatively innocuous compounds as silicon dioxide, ferric oxide, alumina, calcium oxide, magnesia, titania, etc. for the potentially hazardous zinc, lead, antimony and asbestos fillers currently in use. Organozinc compounds also appear at substantial levels in lubricating oils for motor vehicles. Although such zinc compounds are generally much more toxic than inorganiz zinc, they do not constitute an additional hazard since they have a very short half-life upon exposure to the elements. Since considerable quantities of traffic-deposited oils are found on roadways, it is recommended that attempts be made to reduce or eliminate the use of zinc in automobile lubricants.

Vehicle Design Changes for Containment of Nonexhaust Vehicular Emissions

The recent introduction of positive crankcase ventilation devices on newer automobiles has no doubt served to reduce the deposition of grease on urban roadways. Petroleum products are being deposited by motor vehicles through leaks of grease, lubrication oil, brake fluid and transmission fluid. These materials then act as a recurrent low-level "oil spill" as they enter receiving waters during runoff events. Leaks generally occur at discrete locations from the vehicle and it should be possible to install collection pans so as to trap most of this material. It is recommended that such equipment be designed and tested to determine the practicality of this approach as well as the amounts of petroleum products which are actually retained.

A rather large magnetic fraction has been found in area roadway samples, as much as 7% by weight in some cases. It is believed that most of this material is contributed by local soils. However, some of fraction is derived from corrosion of motor vehicle bodies, exhaust systems and from scoring of cast iron brake drums. While the magnetic corrosion products are not toxic in themselves, they carry along some of the trace heavy metals with which iron is alloyed, i.e. chromium, nickel, cadmium, etc. Development of mechanical trapping devices for these substances should be considered if it is demonstrated that low levels of these associated metals are having significant effects upon water quality or aquatic life in urban areas.

Motor vehicle clutch and braking systems are a third area in which it should be possible to develop mechanical containment systems. Brake linings are fabricated with considerable quantities of copper in order to dissipate heat and provide extra mechanical strength. This copper is then deposited on roadway surfaces during normal wear of the brake linings. The public health aspects of asbestos, the major component of brake and clutch linings, as a water and air pollutant, have been the subject of nationwide interest. A recent study (9) has shown that over 99.7% of the materials abraded from clutch and brake linings is converted to nonasbestos products. Of the remaining 0.2 to 0.3%, 82% is deposited on roadway surfaces, 14% is retained in the housing, and the remaining 4% becomes airborne. The hazardous potential of these asbestos emissions should be determined, both as a source of water and air pollution. A brake shroud was used in this study for trapping brake emissions so that a mass balance and emission distribution pattern could be obtained. The shroud effectively captured brake emissions and could serve as a prototype for a practical brake and clutch emission control device. It is recommended that asbestos containment systems for brake and clutch systems be developed and tested.

Litter

In any investigation of urban roadways, one cannot help but be impressed with the amounts of unsightly litter which appears in the vicinity of streets and highways. Although it has already been determined that such litter is of minimal importance as a water pollutant, the resultant lowering of the esthetic quality of an area by litter from motor vehicles is significant. Adequate litter collection and disposal systems are not available to motor vehicle operators and thus contribute to the frequency of unlawful littering. It is recommended that increased efforts be made to enlist public support for anti-litter campaigns as an integral part of an overall program by the Federal Government to improve environmental quality. Public service messages by the news media and particularly by the automobile manufacturers should be encouraged. Adequate anti-litter legislation exists at the state and local government levels; however, these laws should be more rigorously enforced.

ADDITIONAL STUDIES

Impact of Roadway Runoff

The impact upon receiving waters of some components of urban roadway runoff are apparent or can be predicted based upon present knowledge. For example, the hazards associated with solids, oxygen demanding substances, nutrients, and other pollutants are largely understood. However, actual effects which may be associated with some other runoff constituents are not defined. In order to achieve practical control measures for all aspects of roadway runoff pollution, the effects of the runoff upon receiving waters must be more precisely determined. It is recommended that a study be initiated in the near future which will determine the effects of roadways upon receiving waters. This study should include a determination of physical, chemical and biological alternations induced by the highway both during runoff events and on a long-term basis.

Reuse of Stormwater Runoff

It appears probable that runoff storage systems will become an important part of stormwater management. The potential for use of this water source in urban areas should be determined.

Sampling Procedures for Street Surface Contaminants

One of the significant achievements of this study has been the development and evaluation of a quantitative technique for collection of street surface contaminants for subsequent determination of loadings. It is recommended that the technique be subjected to review so as to propose it as a "standard method" for collection of roadway samples.

Contributions of Urban Roadway Usage to Asbestos Exposures

It is recommended that studies be initiated in the near future which quantify the contributions of motor vehicles to asbestos exposures in urban areas. This study should examine for asbestos in public drinking water as well as studying the air pollution hazards.

Development and Standardization of Analytical Methodology for Roadway Deposits and Runoff

Examination of analytical data from various studies of urban runoff has indicated that the results obtained are not always comparable. Part of this difficulty may be a result of the diversity of analytical methods in use which may not give similar results. Standardized methods (1,2) most frequently used for estimation of pollution parameters are intended for measurements on surface waters, industrial and sanitary wastewaters and have not been adequately tested for analyses of particulates or stormwater runoff. Certain modifications to these methods had to be made in order to analyze particulate roadway deposits. Many of the methods need to be further evaluated and improved. As a specific example, the digestion procedure used in the estimation of heavy metals in roadway deposits should be tested to ensure that quantitative recoveries are achieved. Standardization of analytical methods for roadway runoff and particulate street surface contaminants is recommended.

It is believed that one of the contributing factors to the high COD/BOD ratios observed in this and other studies of roadway runoff is the inability of the classical BOD method to deal with these types of samples. Particle size reduction and/or stirring during the incubation period may overcome some of the difficulties encountered. A laboratory study of this problem is recommended so as to identify the causes and improve the method.

Methods for the determination of rubber and asbestos, developed specifically for this study, need to be further improved, refined and tested if other studies of these pollutants are to be carried out. The asbestos method, in particular, needs to be upgraded so as to obtain results comparable with those found in other environmental samples. Further development of methods for asbestos in runoff and roadway deposits should be based upon electron microscopic techniques.

SECTION III

INTRODUCTION

BACKGROUND

Until rather recently, most treatises on the subject of urban runoff began with qualitative statements stressing that this was an important source of pollution and that runoff waters from urban areas, rather than being relatively pure, were, in many instances, comparable to raw sewage. Numerous studies have now been completed and others are in process which have served to characterize and quantify the water pollution problems associated with runoff from urbanized areas. After a rather slow start, reports and summaries issuing from these studies within the past several years and the attendant publicity have served to disseminate this information to concerned parties in an effective manner. Once the nature and significance of runoff from urban areas were realized, a logical sequence of investigations was initiated to study, measure and develop control measures for various factors contributing to the total problem. Quite naturally, the Environmental Protection Agency (EPA) has been the most active Government Agency in promoting and endorsing research in this critical area. More recently, other Agencies have become aware of the problem and are now funding programs dealing with aspects of the problem related to their particular needs and interests. Thus, the significant contributions of urban stormwater runoff to water pollution are now quite widely appreciated and studies of particular facets of the problem are continuing.

City and suburban streets and highways act as effective collectors of dust and dirt from many activities within an urban area. The accumulated materials deposited on urban roadways are then swept in an efficient manner to area receiving waters during periods of runoff. Thus, the interface of urban roadways, having high collection efficiencies and runoff coefficients, with storm sewers constitutes an effective and rapid transport system for carrying materials deposited on roadways into receiving waters during runoff events.

A review of the pertinent literature was conducted (see Appendix H), in partial fulfillment of the contract requirements. In order to summarize prior knowledge of the urban runoff problem and the magnitude of contributions of urban roadways, the following conclusions drawn from the literature survey are given:

1. The pollutional load imposed on receiving waters by urban runoff is significant on a shock load basis, and in many cases, on a yearly or steady flow basis.

2. The contribution of streets and roadways to urban runoff pollution is significant.

3. Based upon statistical analysis of the limited amounts of data available prior to this program, the contributions to streets and roadways by motor vehicular traffic is of major importance.

4. The concentrations of pollutants in urban runoff may be higher than those of sanitary sewage during portions of the runoff event.

It is not surprising that roadways have a significant effect upon urban runoff since they constitute a high percentage of the total area in cities; and, being impervious, roadway surfaces have high runoff coefficients. Prior to the present program, there have been two in-depth studies relating to the contributions of runoff from streets and roadways to water pollution. The first study (10), conducted for EPA by the American Public Works Association (APWA), surveyed all factors contributing to urban runoff and concluded that:

> "The most determinable measure of pollution potential of street litter was deemed to be the BOD of the soluble dust and dirt fraction. This BOD varied from three to 14 mg/g of dry material. As stated, the average was 5 mg/g. This amounted to 0.40 pounds of BOD per day per curb mile. Compared to the BOD reduction of 80% considered attainable for secondary treatment of sewage, the BOD of the street litter was equivalent to 25 persons per day per mile. National population densities per mile of roadways and streets indicate that for a city of Chicago's size, 500 persons would live adjacent to each mile of street. Thus, with a street litter BOD equivalency of five persons per day per mile, street litter would have a pollution potential of 1% of the raw sewage pollution loading and 5% of the secondary treatment effluent described above."

The second significant study (11) was conducted by URS Research Company into the water pollution effects of street surface contaminants. The investigators stated that, "It is with reasonable assurance that we conclude that street surface contaminants represent a significant nonpoint source of pollution of receiving waters." These two studies produced the first quantitative information on the surface loadings of pollutant per unit area or length of roadway. Variations in loadings with land use, zoning, traffic intensity and other factors were presented.

Analysis of data reported by APWA in a study of gutter sweepings from Chicago in 1967 gave the first positive clue that loadings on roadways were a function of motor vehicle traffic. Statistical analyses of APWA data revealed strong indications that amounts of pollutants in dust and dirt samples were directly proportional to traffic intensity, regardless of zoning, land use, street width and other factors although the present study has shown that traffic contributions may be masked or overridden by other land use effects in certain areas.

OBJECTIVES

The overall objectives of this investigation were aimed at the isolation, identification and estimation of specific contributions of motor vehicular traffic to materials deposited on urban roadways and thus to urban stormwater runoff pollution. Specifically, the individual objectives were as follows:

- Perform a comprehensive survey of existing literature to summarize prior studies of urban runoff and the contributions of streets and roadways.

- Develop and evaluate techniques and methods for sampling materials deposited on roadways. The aim here is not only to ensure that meaningful and representative samples are acquired for this study, but to develop a satisfactory sampling protocol for use in future studies of this type.

- Determine the specific contributions of motor vehicular traffic to materials deposited on roadway surfaces which eventually become pollutants in stormwater runoff. This is the principal objective of the study and requires that contributions from such factors as land use and fallout of industrial air pollutants be minimized.

- Attempt to define sources and origins of traffic-related pollutants found in dust and dirt deposited on roadways.

- Continue investigations into the nature of materials deposited on roadways to include its concentrations of pollutants, chemical composition, particle size distribution and composition, physical appearance, etc.

- Monitor a number of runoff events in which rate of rainfall, rate of runoff and composition of runoff are measured.

- Develop recommendations for control and abatement of this source of urban runoff pollution.

- Develop recommendations for future studies.

Since the principal objectives of the study were to evaluate contributions of motor vehicles to urban runoff, it was desirable to perform the actual investigations in an urban area having minimum contributions from other sources. The Washington, D.C. area, with its population of over 2.7 million, has roadways and traffic patterns typical of all large cities, yet has the lowest industrial profile of any major metropolitan area in the country. Thus, the area selected probably represents the most favorable location in which this type of study can be carried out.

PROJECT OVERVIEW AND DESCRIPTION

The project was organized into a number of separate tasks encompassing the above-mentioned objectives in an effective manner. These tasks were as follows:

Task 1. Gather Background Information

The literature survey was accomplished as part of this task. In addition, numerous technical discussions were held with knowledgeable parties in order to obtain information relative to other aspects of the study.

Task 2. Develop Sample Collection Techniques

A procedure was developed and a protocol written for sampling materials deposited on roadways. Procedures for blocking traffic lanes of streets and highways so as to accomplish sampling were devised and approved by the appropriate authorities having jurisdiction over the roadways.

Task 3. Select Roadway Sampling Sites

Specific roadway sampling sites were selected from the metropolitan Washington, D.C. area to encompass a variety of road uses.

Task 4. Establish Laboratory Procedures

Standard methods for analysis of pollutants to be measured under this program are written for water samples. Modifications were made in most cases in order to apply them to particulate materials deposited on roadways. Several new analytical methods had to be developed for non-routine pollutants.

Task 5. Establish a Project Review Panel

An advisory panel of experts was established to advise and assist the project. Panel meetings were held to review progress and discuss special problem areas.

Task 6. Conduct the Twelve-Month Field Study

Roadway samples, traffic and other related data were gathered during the 12-month field study. Stream bottom surveys were conducted along with a number of special experiments. Laboratory analyses of pollutants were performed on samples.

Task 7. Process Data

Computer programs were written for statistical analysis of the data. The data were calculated, tabulated and stored in the computer.

Task 8. Prepare Report

Monthly and quarterly progress reports and a final technical report were prepared. The project scheduling diagram used to monitor progress on the individual tasks is shown in Figure 2.

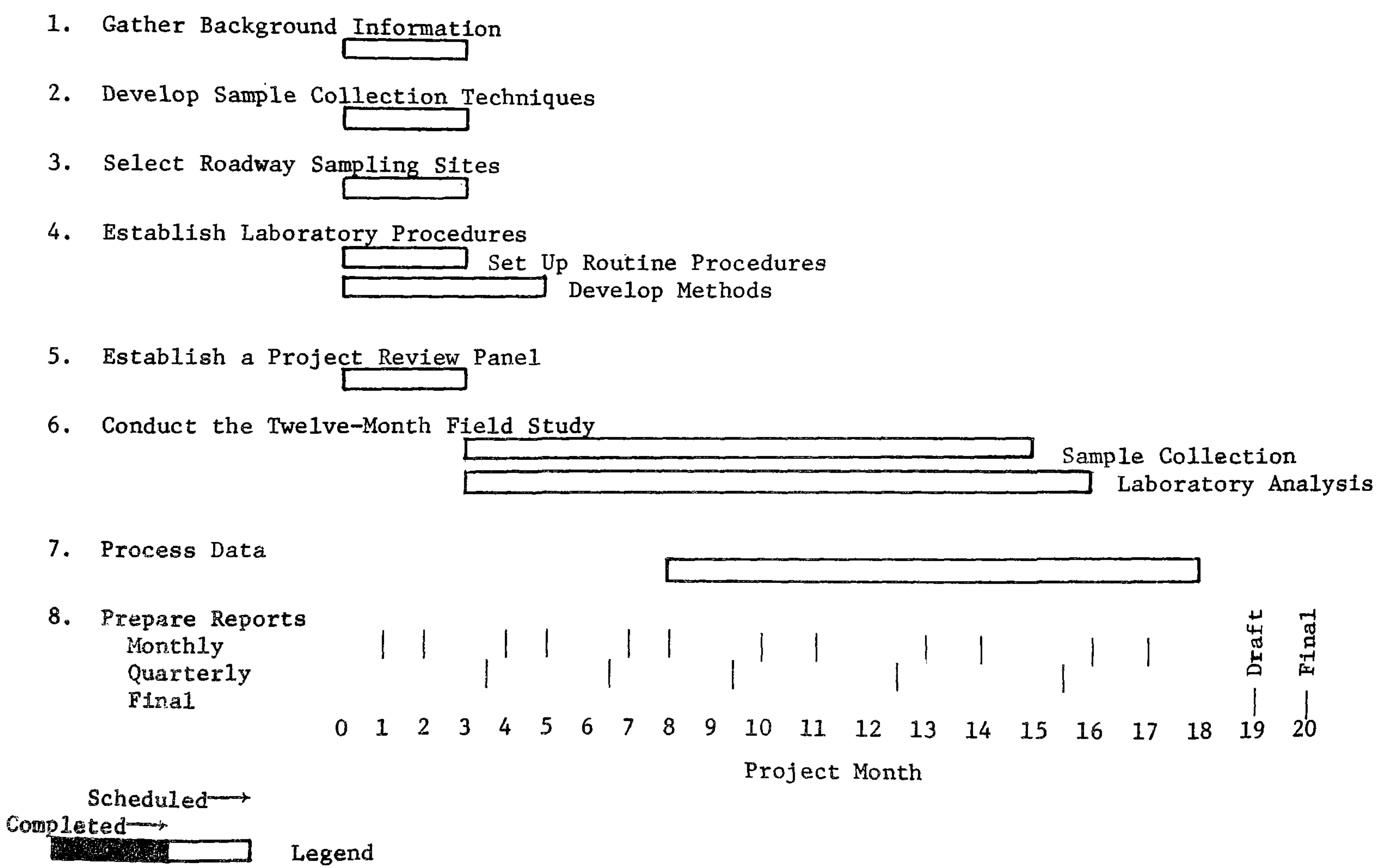


Figure 2. Urban runoff pollution from roadways project scheduling diagram

SECTION IV

TWELVE-MONTH FIELD STUDY - EXPERIMENTAL METHODS

TWELVE-MONTH FIELD STUDY - OVERVIEW

A 12-month field study was carried out on Washington, D.C. Metropolitan area streets and highways in order to determine traffic-related deposition rates of roadway materials. Secondary objectives of the field study were to acquire samples for special studies into the nature of roadway dust and dirt and to develop data which could be examined for the effects of seasons, speed, land use, traffic mix and roadway materials of construction. The following descriptive outline is presented to develop the rationale and give an overview of the 12-month field study:

1. Specific sites of known dimensions were selected on seven area roadways for sampling of deposited materials. The area roadways were chosen primarily so as to reflect a variety of average daily traffic levels and road use categories. Secondary considerations in roadway selection were land use, materials of construction and speed limit.

2. The roadway sites were sampled following a schedule which allowed for examination of the resultant data for seasonal effects.

3. Each roadway site sampling period lasted about a week and generally consisted of collection of an initial sample followed by collection of samples which were deposited over daily, weekend and, in a few instances, longer periods of time. Since the daily and weekend samples were collected from previously cleaned roadway surfaces, they represented deposition which had occurred over a known time interval.

4. Total traffic passing the roadway sampling site was measured for the time of deposition of each daily and weekend sample. A breakdown of total traffic into several vehicle categories was determined by manual count for each sampling period.

5. Particulate roadway materials were separated on the basis of particle size into a litter fraction and a dust and dirt fraction. A water flush fraction of the roadway area sampled was collected in most cases so as to pick up those constituents of roadway dust and dirt which were not gathered at high efficiencies by the particulate collection techniques.

6. These fractions of each sample were individually analyzed for the pollution parameters of interest. Pollutant loads were calculated on a curb-mile basis from the total weight or volume of the fraction, concentration of the pollutant and length of the roadway sampling site.

7. Pollutant loads were plotted against total traffic, the least squares lines calculated and correlation coefficients determined. Other analyses were performed on the data.

DESCRIPTION OF ROADWAY SITES

A number of factors had to be considered in the selection of area roadways and specific roadway sampling sites for the 12-month field study. As stated previously, seven area roadways were chosen for the field study based primarily upon the range of average daily traffic levels and road use categories encompassed. Other factors considered in the roadway selections were speed limit and roadway surface material. Satisfactory condition of the street surface and a sufficient length of curb against which the sample could be deposited and collected were important factors in selection of the specific sampling sites on the area roadways chosen. Site lengths of 60 feet were sampled at Kenilworth Avenue early in the program. Site curb lengths were then increased to 80 feet on I 495 and to 100 feet or longer on all other sites. Some information relative to land use effects was desired as part of the study. However, sites selected for the study of land use effects would not provide satisfactory data for the principal objective, determination of traffic-related deposition rates. Therefore, most of the roadway sampling sites were selected at areas where surrounding land use effects were at a minimum and did not override or obscure the amounts of materials deposited on roadways as a result of motor vehicular traffic. The road use category and average daily traffic for each of the roadway sampling sites is given in Table 7. Other descriptive information for the roadway sites is presented in Table 8. Photographs showing the sampling sites and surrounding areas are presented in Figure 3.

It was believed that roadway depositions resulting from land use effects were negligible at all of the roadway sites with the exception of Loehmann's Plaza Shopping Center and the site at New Jersey Avenue and E Street, N.W. Contributions from motor vehicles were masked at these sites by other land use activities. Substances found on the roadway serving the shopping center contained considerable quantities of material discarded by pedestrians from package and food wrappings. Samples were gathered from along the curb of this roadway which contained sweepings from the pedestrian mall and substantial amounts of humus from planters within the shopping center. The CAMP (Continuous Air Monitoring Program) Station site on New Jersey Avenue is situated between a liquor store and a fire station on one side and a motor inn on the other. The large nonvehicular contributions to materials deposited on the street surface were principally due to heavy construction across the street from the site and roadway surface repair activities just south of the site.

TABLE 7. WASHINGTON, D.C. METROPOLITAN AREA ROADWAY SAMPLING SITES

Roadway Sampling Site	Average Daily Traffic[a] (axles)	Road Use Category
Interstate Route 495, eastbound lane near New Hampshire Avenue exit -	109,000	Expressway
Baltimore-Washington Parkway, southbound lane south of the Route 202 exit -	73,000	Expressway
Interstate Route I 95, unopened southbound portion south of Route 495 -	0	Expressway
Kenilworth Avenue, high speed southbound lane near Eastern Avenue -	83,000	30-45 mph Feeder
Kenilworth Avenue, low speed southbound lane near Eastern Avenue -	83,000	30-45 mph Feeder
New Jersey Avenue at E Street, N.W., in front of the CAMP Station -	5,800	Residential
North Capitol Street, N.E., high speed northbound lane near Girard Street -	40,000	Residential
North Capitol Street, N.E., low speed northbound lane near Girard Street	40,000	Residential
Loehmann's Plaza Shopping Center, Rockville, Maryland	2,600	Parking Lot

(a) The daily traffic volumes given are for motor vehicles moving in one direction along the roadway.

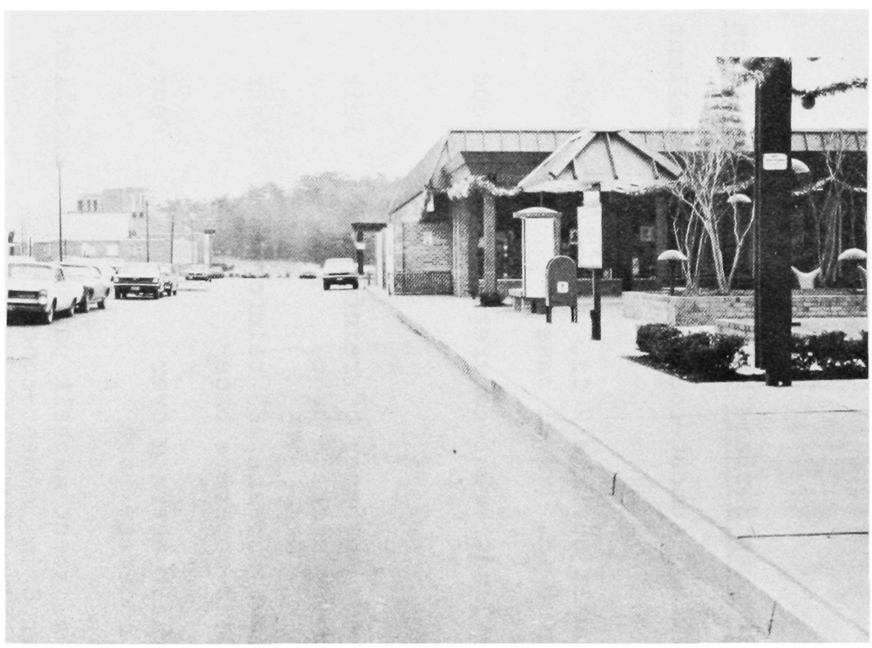
TABLE 8. DESCRIPTIVE INFORMATION FOR ROADWAY SAMPLING SITES

Site	85 Percentile Speed mph	Speed Limit	Zoning Description and Classification	
I 95	Not Applicable	Not Applicable	R-R	Rural residential, single family
Loehmann's Plaza	Not Available	Not Specified	C-1	Local commercial
I 495 Beltway	66+	65 mph 60 mph for trucks	R-60	One family detached residential zone
Kenilworth Ave. Low Speed Lane	46.0	45	R-1-B	Single family dwelling
Kenilworth Ave. High Speed Lane	46.0	45	R-1-B	Single family dwelling
CAMP Station New Jersey & E, N.W.	27.0	25	C-3-B	Commercial
North Capitol St. High and Low Speed Lanes	40.0	30	R-3	Row houses, single family dwelling, residential
Balto.-Wash. Pkwy.	60.0	45	R-18	Residential apartments

TABLE 8 (CONTINUED). DESCRIPTIVE INFORMATION FOR ROADWAY SAMPLING SITES

Roadway Surface Material	Condition	Curb Material	Curb Height	Slope of Roadway	Rate of Slope
Portland cement-concrete	Excellent	None	None	Not Available	
Asphalt surface 2 in. over 6 in. gravel base	Fair	Cement-Concrete	6 in.	1%	0.5%
Portland cement-concrete	Good	Asphalt Surface Over Cement-Concrete	2 ft. 9 in.	1.6%	3.40%
Cement surface, 8" reinforced cement-concrete base	Fair	Cement-Concrete	7.5 in.	Not Available	0.5%
Cement surface, 8" reinforced cement-concrete base	Fair	Cement-Concrete	3 ft. 9 in.	Not Available	0.5%
Asphalt surface over 6" concrete base	Poor	Vitrified Block	4 in.	0.51%	4%
1 in. sheet asphalt pavement over 8 in. cement-concrete base	Excellent	Cement-Concrete	6 in.	0.11%	1.53%
Cement-concrete, 6 in. over gravel base	Fair	Cement-Concrete	4 in.	0.5%	0.5%

Interstate Route 495, Eastbound Lane



Loehmann's Plaza Shopping Center

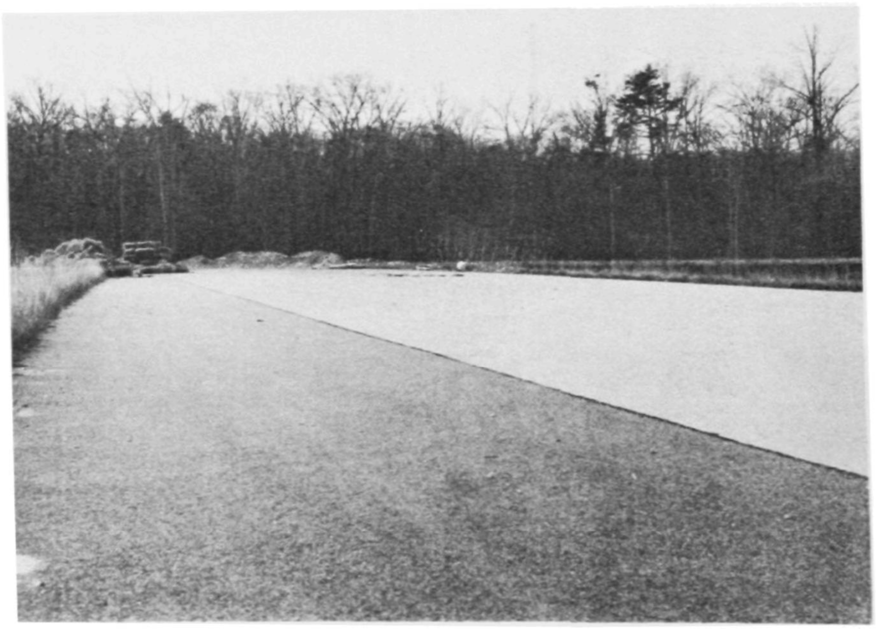
Figure 3. Roadway sampling sites and surrounding areas

North Capitol Street, N.E. - Low-Speed Lane

North Capitol Street, N.E. - High-Speed Lane

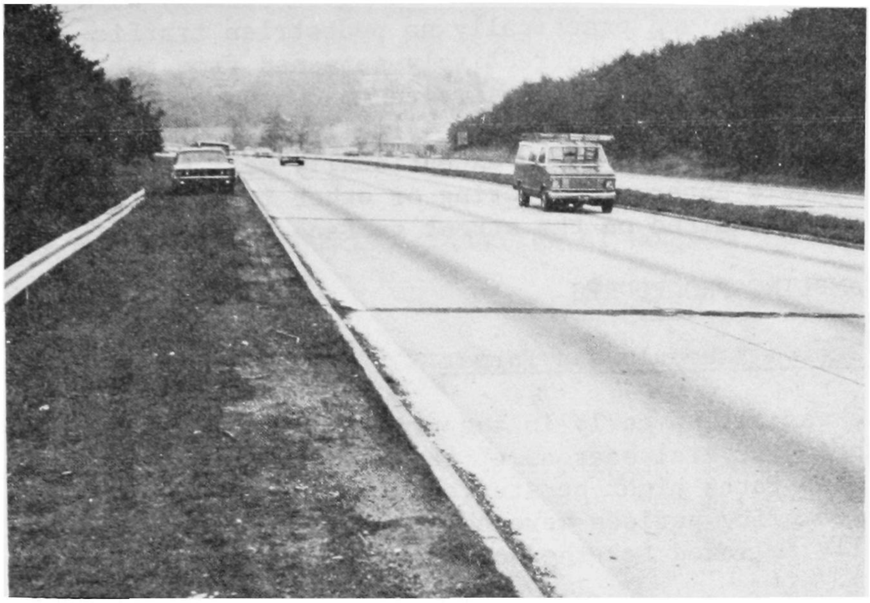
Figure 3 (continued)

Kenilworth Avenue, N.E.



Unopened Section of Interstate Route 95

Figure 3 (continued)



Baltimore-Washington Parkway

New Jersey Avenue at E Street, N. W.

Figure 3 (continued)

The immediate areas adjacent to sites on Interstate Route 95, Interstate Route 495 and the Baltimore-Washington Parkway were sparsely populated and received practically no pedestrian traffic. The sites on Kenilworth Avenue were effectively screened from the surrounding residential area by a parallel service roadway separated from the main thoroughfare by a wide grass mall. Finally, the sites along North Capitol Street, N.E. are in an exceptionally well kept residential area with very little apparent littering or other interfering contributions to materials deposited on the street surface.

ROADWAY SAMPLING PROCEDURES

Sampling Period Schedule and Format

A schedule was set up early in the program such that the roadways were sampled during several seasons of the year in order that seasonal effects on deposition rates might be studied. Table 9 lists the seasons during which the sampling periods were conducted at each of the sites. The schedule actually followed for the sampling periods is given in Table A-2 of Appendix A.

Sampling periods were scheduled to begin on a Monday and end one week later on the following Monday. Sample collections were planned to be carried out in the following manner:

1. An initial sample was obtained by cleaning the roadway surface and quantitative collection of materials initially found on the site. No measurements of traffic were taken to correspond with the initial sample; however, records of precipitation and dates of the most recent antecedent cleaning of the roadway surfaces were maintained throughout the 12-month field study.

2. The site was sampled a second time after an accumulation period of approximately 24 hours during which time a measured volume of traffic passed the roadway site. As many as four samples having a one-day accumulation period were taken during the remainder of the week. Traffic counts were taken with each one-day sample.

3. The final sample of the period was gathered following the weekend. Ideally then, a sampling period consisted of an initial sample, four one-day samples and a weekend sample with traffic data for all samples except the initial one.

4. Precipitation frequently interrupted the planned pattern of the sampling periods. Samples were gathered after rainstorms in a few cases; however, it was felt that such samples would be atypical; and, therefore, collections

after runoff events were abandoned early in the program. The roadway site was cleaned as soon as convenient after precipitation had ceased and a new sample accumulation period begun. Sampling periods were extended in some instances in order to make up for loss of samples due to precipitation.

TABLE 9. SEASONAL SAMPLES COLLECTED AT ROADWAY SITES

	Seasons of Sampling Periods			
Roadway Sampling Site	Winter	Spring	Summer	Fall
Interstate Route 95			X	
Loehmann's Plaza Shopping Center			X	X
Capitol Beltway, I 495	X	X	X	X
Kenilworth Ave., Low-Speed Lane	X	X	X	X
Kenilworth Ave., High-Speed Lane	X	X	X	X
CAMP Station, New Jersey Avenue	X	X	X	X
North Capitol Street, Low-Speed Lane	X	X	X	X
North Capitol Street, High-Speed Lane	X			
Baltimore-Washington Parkway	X	X		

Sample Fractions

Samples of materials deposited on roadways were collected using a combination of sweeping, vacuuming and water flushing techniques. Each sample consisted of three fractions, a litter, a dust and dirt and a flush fraction. The particulate materials collected by sweeping and vacuuming were separated on the basis of particle size into a litter fraction and a dust and dirt fraction. The litter fraction consisted of that portion of the particulates retained by a U.S.A. No. 6 sieve, greater than 3.35 mm in diameter. This fraction is largely composed of stones, gravels, wood fragments and other larger-sized materials as opposed to bottles, cans, paper products, etc. normally thought of as litter. The dust and dirt fraction contains those particulates smaller than 3.35 mm in diameter. The third or water flush fraction contained those components of the dust and dirt fraction which were not picked up at high efficiencies by the sweeping and vacuuming techniques. Thus, the flush plus the dust and dirt constitute a total dust and dirt fraction which is the major source of water pollutants found in runoff from urban roadways.

A total of 26 sampling periods were carried out at nine sites on seven roadways in the Metropolitan Washington, D.C. area. A total of 127 roadway samples were acquired in the course of the 12-month field study. There were 127 litter fractions, 127 dust and dirt fractions and 82 flush fractions collected. Flush samples were not gathered at Loehmann's Plaza Shopping Center or from the high-speed lane of Kenilworth Avenue as the roadway surfaces sloped away from the barriers at these sites. Freezing conditions prevented collection of six flush fractions during the winter sampling period on the low-speed lane of Kenilworth Avenue. No flush fraction was collected with one initial sample from the Capital Beltway and two flushes were not taken with daily samples acquired after a rainstorm. Table A-1 in Appendix A lists the dates for collection of each sample along with the sample fractions gathered and volume of traffic passing the site during each sample collection period.

SAMPLING PROCEDURE FOR MATERIALS DEPOSITED ON ROADWAYS

Description of the Sampling Procedure

One of the most important phases of the project study was the development of quantitative sampling techniques and methods to give representative and meaningful collections of vehicular waste depositions. A full three months prior to the 12-month field study was devoted to the development and evaluation of the sampling procedure. Additional evaluations through data analysis and special experiments were carried out during the field study. This procedure, described in Appendix E, entailed a preliminary brooming of the roadway site, if it was heavily loaded, followed by three consecutive vacuumings of the area within four feet of the curb or other barrier against which the roadway depositions collect. A previous study of the distribution of materials across urban streets has shown that over 95% of the deposits are found within this distance (8). After vacuuming, the entire roadway site area was flushed with water toward the curb. The area adjacent to the curb was then flushed toward a sand bag dam where the impounded water was transported by suction into a 55-gallon drum.

Evaluation of the Sampling Procedure

The vacuum cleaner used for collection of roadway particulates, shown in Figure 4, consisted of a pick-up head attached to a 10-gallon canister on the top of which was mounted an exhaust motor. Exhaust ports from the canister leading to the motor were covered by a filter bag to retain solids picked up during the vacuuming operations. Since the finer particles found on roadways have previously been shown to be relatively more heavily laden with pollutants (8), experiments were performed to determine the retention of smaller-sized particles by the filter bag. Several hundred grams of material passing a U.S.A. No. 325 mesh sieve, smaller than 0.045 mm in diameter, were obtained by sieving particulates vacuumed from a parking area surface. A weighed amount of these fines, approximately 50 grams, was spread over 35 square feet of asphalt tile flooring. The floor area was then vacuumed and the collected material weighed. Recoveries of 99%, 93% and 94% were obtained using a new filter bag with each experiment. These tests indicate satisfactory retention of fine particulates by the filter bags as well as quantitative removal and recovery of vacuumed particles from the canister walls and bags.

Two areas were marked off on a parking lot surface of rough textured asphalt for use in development and evaluation of the roadway vacuuming

Figure 4. Vacuum cleaner used for roadway sampling

techniques. This type paving was selected as it was felt to be more difficult to sample than other road surfaces which would be encountered. The base asphalt surfaces were cleaned by repeated vacuuming, flushed with water and then allowed to dry. The cleaned areas were then vacuumed several additional times and the collected materials weighed. As a result of conducting several of these operations, it was concluded that from 10 to 40 grams of roadway material would be gathered from 1,000 square feet of clean street surface by each vacuuming. Most likely the collected materials consisted of substances abraded from the surface during vacuuming. Similar tests were carried out on a virgin concrete surface at an unopened stretch of Interstate Route 95. As before, the concrete test surface was precleaned by multiple water flushes and vacuumings. From 15 to 50 grams of abraded material were collected with each vacuuming per 1,000 square feet of concrete roadway surface. Soft bristled brushes were used on the metal vacuum head to prevent contact between the metal and roadway surfaces. This was important from another aspect since the metal vacuum head was fabricated from a high zinc alloy. Thus it was essential to reduce abrasion to a minimum if accurate zinc deposition rates were to be obtained.

Recoveries of a specially prepared dust and dirt simulant spread over the asphalt and concrete paving were satisfactory. The simulant was prepared from sand and had a particle size distribution similar to that of dust and dirt found on roadways. Recovery data from the tests with simulant are given in Table 10.

Similar recovery experiments were conducted on the rough textured asphalt test surface using roadway dust and dirt collected from a nearby street located in a commercially zoned area. These data are given in Table 11. Again, the results obtained showed that essentially all of the materials deposited on the roadway were collected by the first two or three vacuuming operations.

Further experiments were conducted in order to determine effects of the vacuum collection operations on particle size distributions of the deposited roadway materials. Roadway dust and dirt simulant were subjected to sieve analysis before and after spreading and collection by vacuuming. U.S.A. Mesh Nos. 6 (3.35 mm), 12 (1.70 mm), 20 (0.85 mm) 40 (0.42 mm), 60 (0.25 mm), 100 (0.15 mm), 200 (0.075 mm) and 325 (0.045 mm) sieves were used for the particle size distribution analyses. Recoveries of the individual sieve fractions after three vacuuming operations are shown in Table 12. Recoveries on asphalt surfaces of the greater than Mesh No. 6 fraction were generally over 100% and indicated that larger asphalt particles were abraded off of the parking lot surface during sample collection. Less than quantitative recoveries were noted for this fraction from concrete surfaces; and, rather than incomplete collection, it was concluded that losses were due to reduction in particle sizes caused by mechanical forces during vacuuming. Simulant recoveries from concrete and asphalt surfaces tended to increase as particle sizes decreased below U.S.A. Mesh No. 6 (3.35 mm) indicating that simulant particles were abraded and reduced in size during collection. Simulant recoveries in the 6-12 mesh fraction ranged from 60% to 90%, from 95% to 115% in the 40-60 mesh fraction and from 350% to 1,300% in the fraction passing the Mesh No. 325 sieve. Recoveries observed in a similar experiment with actual roadway dust and dirt indicate that these particles are more stable as near quantitative recoveries were obtained for all particle fractions smaller than 3.35 mm.

The water flush procedure was tested prior to use in the field. It was found that a roadway area of 1,000 square feet could be thoroughly flushed with about 25 gallons of water. In most cases, over 50% of the applied flush was recovered by vacuuming of the impounded water along the curb. Most of the unrecovered flush water remained behind on the roadway or was lost by evaporation or seepage through cracks in the street surface.

Less than one-half gallon was lost during collection through leakage past the sand bag impoundment.

TABLE 10. EVALUATION OF SAMPLING PROCEDURE - RECOVERIES OF ROADWAY DUST AND DIRT SIMULANT BY VACUUMING[a]

Surface	Area (sq. ft.)	Simulant Added (g)	Vacuum No.	Simulant Recoveries (g)	Simulant Recoveries (%)
Asphalt	912	1000.1	1	1052.2	105
			2	53.8	5
			3	77.4	8
			4	39.0	4
			5	34.1	3
			6	18.1	2
Asphalt	912	1000.2	1	1018.0	102
			2	43.9	4
			3	33.0	3
			4	27.2	3
Asphalt	629	1000.2	1	1010.4	101
			2	25.6	3
Concrete	600	1000.7	1	1014.1	101
			2	37.8	4
			3	20.2	2
			4	20.9	2
Concrete	600	1000.0	1	1009.3	101
			2	22.2	2
			3	11.3	1
			4	11.0	1
Concrete	600	1000.6	1	1105.2	110
			2	35.5	4
			3	14.2	1
			4	9.3	1

(a) Simulant was supplied by the URS Research Company of San Mateo, California.

TABLE 11. EVALUATION OF SAMPLING PROCEDURE - RECOVERIES OF ROADWAY DUST AND DIRT BY VACUUMING FROM ROUGH TEXTURED ASPHALT

Area (sq. ft.)	Dust & Dirt Added (g)	Vacuum No.	Dust & Dirt Recoveries (g)	Dust & Dirt Recoveries (%)
629	1000.1	1	943.8	94
		2	44.2	4
		3	17.5	2
		4	15.1	2
		5	12.2	1
		6	9.2	1
629	1000.7	1	933.3	93
		2	46.4	5
		3	18.6	2
		4	11.1	1
		5	9.3	1
		6	7.1	1
629	941.3	1	905.7	96
		2	37.2	4
		3	13.6	1
		4	8.7	1
		5	7.6	1
		6	9.4	1

Distribution of Pollutants Between Flush and Dust and Dirt

One of the goals strived for during development of sampling procedures for roadway deposits was to have satisfactory recoveries of pollutant in the particulate fractions. This was desirable since flush fractions could not be collected in all cases due to configurations of some roadway sites and because of freezing temperatures during some of the sampling periods. Elimination of the flush fraction would somewhat simplify the sample collections and reduce the numbers of laboratory analyses required. However, it was concluded early in the 12-month field study that the flush fraction must be collected if quantitative recoveries of some roadway pollutants were to be obtained.

Based upon observations made and recovery data generated during development and evaluation of the roadway sampling procedures, it was concluded that the procedures could be carried out in a satisfactory manner by the field crews and that samples representative of roadway depositions would be obtained during the field study. In order to maintain quality control checks on sample collection techniques and to study distributions of specific pollutants in the sample fractions, field study data was subjected to further analysis. It was evident from evaluations made prior to the

TABLE 12. EVALUATION OF SAMPLING PROCEDURE - RECOVERY OF ROADWAY DUST AND DIRT AND SIMULANT FRACTIONS BY VACUUMING

Surface	Recoveries of Indicated Sieve Fractions[a]																			
	Total		6		6-12		12-20		20-40		40-60		60-100		100-200		200-325		325	
	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)
Asphalt	1183.4	118	4.0	235	50.4	85	118.5	90	263.6	87	428.5	117	149.9	143	88.8	375	32.4	675	47.4	1281
Asphalt	1094.9	109	2.8	165	44.9	76	105.8	80	272.1	90	422.6	115	130.9	125	57.7	243	19.8	412	38.3	1035
Asphalt[b]	1036.0	104	1.4	82	39.6	67	105.6	80	261.6	86	411.0	112	127.7	122	53.5	226	14.8	308	20.7	559
Asphalt[c]	1002.9	100	17.5	211	30.0	70	55.9	115	169.1	97	219.6	95	200.5	94	240.8	97	25.5	126	44.1	91
Concrete	1060.5	106	1.4	88	44.0	74	118.3	90	270.0	89	406.6	111	129.8	123	53.1	221	23.4	488	13.9	376
Concrete	1039.5	104	1.3	81	34.6	58	113.9	86	261.9	87	414.3	113	139.5	133	50.5	210	10.5	219	13.0	351
Concrete	1153.3	115	1.9	56	54.1	91	154.1	117	295.8	98	430.2	117	125.2	119	46.9	195	17.2	358	27.9	754

(a) U.S.A. Standard Testing Sieve No. 6 = 3.35 mm, No. 12 = 1.70 mm, No. 20 = 0.85 mm, No. 40 = 0.42 mm, No. 60 = 0.25 mm, No. 100 = 0.15 mm, No. 200 = 0.075 mm, No. 325 = 0.045 mm openings.

(b) Only two vacuumings were used for this recovery test as opposed to three for all the others.

(c) This experiment was conducted using actual roadway dust and dirt. All others were conducted using a simulant.

field study and from analysis of data collected early in the field study that roadway materials were collected at high efficiencies in the particulate sample fractions. However, high percentages of some specific parameters were found in the flush fraction. Data in Table 13 lists average percentages found in the flush fraction for specific components of dust and dirt. The standard deviation is also listed to indicate the constancy of this fraction. Arbitrarily selecting 80% or better as satisfactory recovery, it is readily apparent that most parameters were adequately recovered with the dust and dirt fraction. The dry weight, heavy metals, asbestos, grease and grease fractions, COD and others were all found largely in the dust and dirt fraction. However, considerable quantities of BOD, Kjeldahl-N, water soluble anions, and microorganisms were recovered with the water flush. This has the interesting implication that recoveries given in Table 13 represent upper limits for collection efficiencies attainable with advanced street cleaners using a combination of sweeping and vacuuming for pickup of roadway deposits from lightly loaded streets.

TABLE 13. DISTRIBUTION OF POLLUTANTS BETWEEN DUST AND DIRT AND FLUSH SAMPLE FRACTIONS

Parameters	Avg. % of Total Pollutant in Flush	% Standard Deviation
Dry Weight	7	8
Volatile Solids	20	13
BOD	36	22
COD	16	12
Grease	19	15
Petroleum	19	13
n-Paraffins	19	14
Total PO_4-P	15	15
PO_4-P	43	42
NO_3-N	69	24
NO_2-N	97	7
Total Kjeldahl-N	33	23
Chloride	43	33
Asbestos	13	31
Fecal Coliforms	76	40
Fecal Strep	44	39
Lead	4	2
Chromium	17	15
Copper	5	4
Nickel	5	2
Zinc	2	1

It was concluded from these data that flush fractions must be collected in order to obtain accurate values for some pollutants. The constancy of recovery with flush fractions made it possible to calculate total dust and dirt loadings (dust and dirt plus flush) in those cases where no flush was collected. It was also concluded that good performance was maintained by the sample collection crews throughout the 12-month field study. The sampling procedures developed and evaluated for use in this program have been thoroughly studied and have proven to be simple and reliable and to provide an excellent means for the determination of loadings on streets and highways.

COLLECTION OF TRAFFIC DATA

Total traffic crossing the roadway sites during each sample accumulation period was measured. The District Department of Highways and Traffic in Washington, D.C. maintains a permanent magnetometer traffic counting station near the sites on southbound Kenilworth Avenue and they supplied traffic data for sampling periods at those sites. Traffic at all other sites was measured using the Fisher and Porter Company Model 31PC-1,000 Junior Counter pneumatic tube counting device shown in Figure 5. Total traffic data for the roadway samples are given in Table A-1 of Appendix A.

A breakdown of the total traffic was determined on one day during each sampling period of the field study. The breakdown consisted of the following vehicle classifications:

- automobiles (including station wagons)
- busses
- panel and pickup tricks (including campers)
- single unit trucks
- semitractor and trailer units

Manual counts of each motor vehicle classification were taken during 15 minutes of each hour over the 12-hour period from 7:00 a.m. to 7:00 p.m. Over 75% of the total daily traffic will have occurred during this period (12). Traffic breakdowns for each sampling period are given in Table A-3 of Appendix A.

CLIMATOLOGICAL DATA

Records of local weather conditions were maintained for the period of the 12-month field study. Local Climatological Data from the U.S. Department of Commerce is given in Appendix G. These data were compiled from official area weather stations at National and Dulles Airports which are located near the Metropolitan Washington, D.C. area. Rainfall at the roadway sites was measured during sampling periods using the Belfort Instrument Company recording rain gauge shown in Figure 6. In this application the rain gauge served only as a go-no-go indicator for the collection of roadway samples. No samples were gathered when detectible amounts of

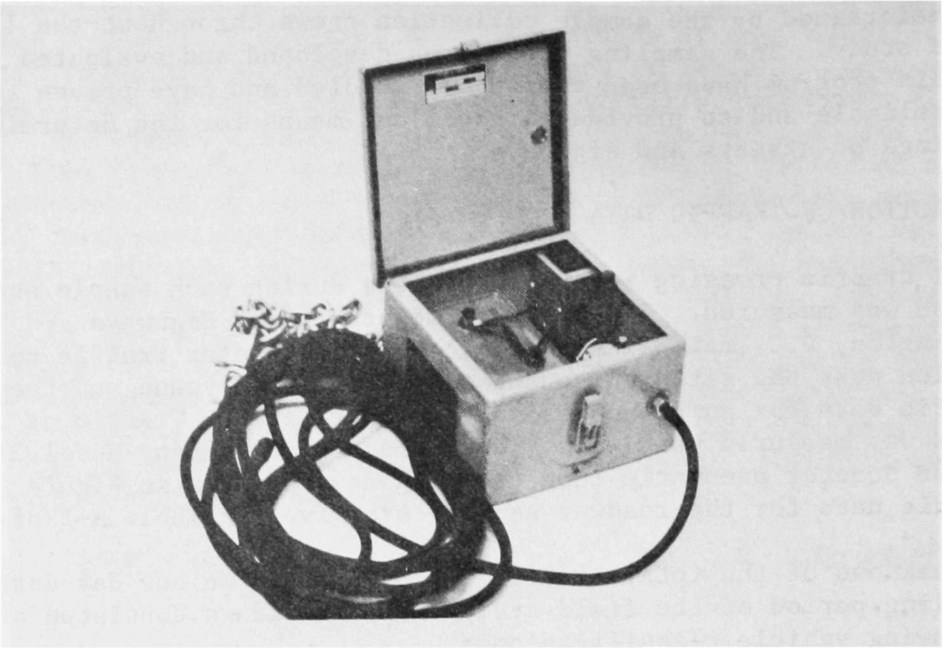


Figure 5. Fisher and Porter Company Model 31PC-1,000 Junior Counter Pneumatic Tube Counting Device

precipitation had occurred during the sample accumulation period; or, if a sample was collected, the resultant analytical data were not used in determination of traffic-related deposition rates for roadway materials.

The cold weather season of the 12-month field study was extremely unusual in that the total recorded snowfall was less than for any previous year for which there are records, back to at least 1933. The total seasonal snowfall measured at the official area weather stations at National and Dulles Airports was 0.1 and 0.9 inches, respectively. The lowest snowfall previously recorded was 4.6 inches in 1943-1944. As a result, there were no widespread applications of deicing compounds or abrasives in the metropolitan area this season. There were some local applications in the District of Columbia, none at the selected roadway sites, as a result of complaints or accidents involving the release of water. No deicing compounds or abrasives were spread on the Baltimore-Washington Parkway south of the Capitol Beltway. Salt (NaCl containing 10% cinders) was spread at the site on I 495 on 14 and 23 February 1973. The area was covered twice during both days at a rate of 300 to 400 pounds per lane mile. As a final footnote on

Figure 6. Belfort Instrument Company Rain Gauge

the unusual weather conditions, a tornado occurred on 1 April 1973 in Falls Church, Virginia just south of Washington. This was only the third such storm recorded in this area, the first tornado since 1927.

ANALYTICAL METHODOLOGY

General

The methodology followed for laboratory processing and analysis of the roadway samples is given in Appendix F. Procedures in Standard Methods for the Examination of Water and Wastewater (13) were followed in most cases. However, numerous modifications were occasioned as these procedures were intended primarily for use with liquid samples and no standard methods exist for the analysis of street surface contaminants. Investigators have used a diversity of methods, some of which need improvement and standardization so that results of different studies can be compared.

Methods for grease and for characterization of grease into hydrocarbon and normal paraffin fractions had to be pieced together from a number of existing procedures. In some cases, no satisfactory methods existed prior to this project for measurement of the parameters of interest. Therefore, methods for the estimation of asbestos and rubber had to be developed for the analysis of roadway samples. Development of these analytical methods and their limitations are discussed in the following sections.

Determination of Rubber

The technique of pyrolysis-gas chromatography was used to develop a method capable of detecting 0.005% rubber in roadway dust and dirt samples. Pyrolysis-gas chromatography was first applied to the identification of vehicle tire rubber in roadway dust by Thompson, et al in 1966 (14). More recently, this approach was used for the quantitative estimation of rubbers in compound cured stocks (15). Styrene-butadiene rubber (SBR) is converted to styrene and other low molecular weight compounds by pyrolysis in a nitrogen atmosphere. The styrene is then separated and measured via gas chromatography using a flame ionization detector. Briefly, the method entailed pyrolysis of 20 to 25 mg of extracted sample for 20 seconds at 640°C in an inert nitrogen atmosphere. Dust and dirt samples were first extracted with aqueous acid to remove soluble materials and carbonates and then with hexane to remove interfering organics. Next, the gaseous pyrolysis products were chromatographed and the styrene peak measured.

SBR is the most commonly used synthetic rubber for vehicle tires manufactured in the United States. Passenger car tires contain 70 to 80% SBR, small truck tires 60 to 70% and large truck tires only 10 to 20% SBR. Since the total traffic at the roadway sites consisted largely of passenger cars, estimation of SBR in dust and dirt will give a satisfactory estimate of tire material in roadway samples. The standard curve shown in Figure F-1 (see Appendix F) was generated by measuring styrene produced upon pyrolysis of known amounts of passenger car tire rubber. No rubber was detected in several of the roadway samples initially examined because of large amounts of interfering compounds produced during pyrolysis. These compounds obscured the styrene peak. A preliminary extraction of the acidified dust and dirt samples with hexane reduced the background interferences to a satisfactory level.

Determination of Asbestos

The method described in Appendix F was developed for the determination of asbestos in dust and dirt and flush fractions of roadway samples. The method was based upon an industrial hygiene procedure recommended for airborne asbestos by the National Institute for Occupational Safety and Health (NIOSH) (16). In this procedure the flush water or aqueous suspension of the dust and dirt was sonicated briefly to disperse particulates and then membrane filtered. The filters were rendered transparent by the action of a mixed organic solvent and the asbestos fibers enumerated using phase contrast optical microscopy. Only fibers between 5 and 100 microns in length and having an aspect ratio (length to breadth) of 3 or greater were counted.

During development of this procedure, a "standard" suspension containing 10 mg/l of chrysotile asbestos was prepared and analyzed repetitively for use in estimating precision and recovery levels. Chrysotile was selected as it is the variety of asbestos most commonly used in the United States. The "standard" suspension was found to contain 10.6×10^4 fibers/ml with a standard deviation of 2.8×10^4 fibers/ml. Recoveries of asbestos fibers added to two dust and dirt samples from I 495 and one from Kenilworth Avenue were 98%, 85%, and 65%, respectively.

Increasing the sonication time from one minute to five minutes did not increase the yield from dust and dirt or from the asbestos "standard" suspension. This indicated that sonication was not fracturing fibers in the samples. Tap water was examined along with subsurface soil samples thought to contain no asbestos fibers in an attempt to check for naturally occurring inferences. No asbestos was found in the tap water (the detection limit in this analysis was about 10^3 fibers/l). Values of less than 3×10^5 fibers/g were found in the two soils examined. The levels found in the soils were at the limit of detection for these particular samples and represent less than one fiber from each soil in over 50 fields counted under the microscope. Detection limits on actual roadway samples were generally over one order of magnitude better than with soils.

The toxicology of asbestos fibers has not been well defined and the NIOSH method is based upon expediency and precedents set by earlier investigators. Further, it was not intended for environmental samples but rather for industrial hygiene purposes at mining operations or plant areas where asbestos products are fabricated. Presently, asbestos analytical methodology is trending toward the use of techniques requiring more sophisticated equipment and considerably more man hours per determination. Transmission and scanning electron microscopy are being used for the most critical analyses of environmental samples to measure fibers below the range of optical methods. Particle size distribution and weight of asbestos found are frequently required in addition to numbers of fibers. Obviously, such techniques are beyond the scope of this project. Notwithstanding limitations of the optical method used for this project, it was desired to conduct a preliminary study to determine whether traffic-related asbestos occurred in roadway materials.

DATA HANDLING TECHNIQUES

Tables of sample identification and traffic data, see Table A-1 of Appendix A, and sample fraction analyses, see Tables B-1, B-2 and B-3 of Appendix B, were prepared for the project. Flush fraction pollutant loadings were calculated for those samples for which no flush was collected. These calculations were made using data in Table 13 on the average percent of each pollutant found in the flush. Pollutant loads were calculated in pounds per curb mile for the litter and dust and dirt fractions by dividing the sample dry weight by the lengths of the sampling sites. The dry weight loadings were then multiplied by the concentration of each parameter to calculate the individual pollutant loadings. Flush fraction loadings were calculated in a similar fashion. Tables of the pollutant loadings are given in Appendix C.

Computerized statistical analyses of the roadway data were made to examine for possible correlations between pollutant loadings and total traffic. Litter loadings and total dust and dirt loadings, the latter being the sum of dust and dirt plus flush fraction loadings, were plotted against total traffic for each sample, excluding initial samples and samples which were collected following runoff events. Least squares linear relationships were calculated along with standard deviations, correlation coefficients and significance levels for the correlations using Student's "t" test. These data are presented in Appendix D.

Pollutant loads calculated for samples collected from along one curb of a roadway having no barrier between traffic moving in opposite directions were paired with the total traffic in that direction. Loadings calculated from samples collected from along one curb of divided roadways having a barrier between traffic moving in opposite directions were multiplied by two and paired with total traffic in that direction. The rationale for this approach is obvious in that deposits due to one directional traffic on an undivided roadway would be distributed along the curb lane running in that direction. Deposits due to one directional traffic on a divided roadway would be distributed along the curb and along the roadway divider, presumably in roughly equal quantities. Actual distributions of materials along the barriers of divided roadways will be described in a latter section of this report. Correlation coefficients and significance of the correlations were uniformly found to increase when calculated in this fashion as opposed to those calculated with no multiplication factor for loads on divided roadways. Thus, the validity of this data treatment was verified.

SECTION V

DEPOSITION OF ROADWAY MATERIALS IN URBAN AREAS

CORRELATION OF ROADWAY LOADING INTENSITIES WITH TRAFFIC

Loading intensities of street surface contaminants measured during the 12-month field study were examined to determine which of the individual parameters were traffic dependent. Observed loadings were plotted as the dependent variable against total traffic and the least square equations of the linear relationships calculated. The graphs, linear equations and correlation coefficients are given in Appendix D. The least squares linear equations have the general form:

$$Y + B + mX$$

where Y is the predicted loading intensity which would be deposited along the roadway, B is the intercept on the Y axis, m is the slope or traffic-related pollutant deposition rate and X is the total traffic which passes the roadway area during the period of deposition. For example, the equation of the least squares line obtained upon plotting total dust and dirt dry weight in pounds per mile against traffic in axles is:

$$\text{pounds/roadway mile} = 96.0 + 0.00238 \text{ times axles}$$

That is, the predicted dry weight of total dust and dirt which would be deposited along a roadway after passage of 100,000 axles is 238 pounds per mile (0.00238 times 100,000). Note that, although the <u>deposition</u> of traffic-related materials occurs at a constant rate, the <u>accumulation</u> of materials along the roadway tends to level off after some period of time due, in part, to traffic-related removal mechanisms which are discussed in a later report section. However, <u>all</u> of the deposited pollutants are available for transport to receiving waters during storms and the deposition rates are valid estimates of the contributions of motor vehicles to water pollution.

The intercept on the Y axis, 96.0 pounds per roadway mile, is the amount of total dust and dirt dry weight which appears as a result of phenomena not related to actual traffic on the particular road. It is anticipated that magnitudes of the Y-intercepts will be dependent upon geographic location and the intensity of local particulate air pollution. Therefore, predictions of total roadway loadings to include traffic-related and other materials are subject to these limitations. Only a very small portion of the intercept is due to materials abraded from the roadway during sample collection. A portion of the intercept is due to a positive bias introduced by the sites at Loehmann's Plaza Shopping Center and on New Jersey Avenue at the CAMP Station. These two roadways had low average daily traffic levels and much of the deposited materials at these sites was related to land use and, therefore, nonvehicular in nature.

In any event, a substantial portion of the Y-intercept results from transport of the particulate pollutants by air currents from some distance. The sample accumulation periods ranged from one to four days for all of the samples used to determine the linear relationships between total pollutant loadings and total traffic. Approximately 75% of the samples had a one-day accumulation period, 20% had a three-day and 5% a four-day accumulation period. Since the rate at which airborne materials are deposited is more nearly time dependent than traffic related, the Y-intercept is no doubt a function of time.

TRAFFIC-RELATED DEPOSITION RATES

Slopes of the least squares lines relating traffic and pollutant loadings from Appendix D are presented in Table 14 along with the significance levels for the relationships as calculated from "t" tests. The slopes are arbitrarily taken to be traffic-related pollutant deposition rates when the significance of the correlation is less than 2%, that is, when the probability of the relationship occurring purely by chance is less than 2%. Thus, for the parameters listed in Table 14, depositions of orthophosphate, fecal coliform organisms, fecal streptococci, cadmium, polychlorinated biphenyls, litter and components of litter on roadways have not been shown to be related to motor vehicular traffic. In addition, no cyanide or hexavalent chromium were detected in any of the roadway samples; and, therefore, depositions of these parameters are not traffic related.

It is rather surprising that total phosphate-phorphorus was found to be traffic related and that orthophosphate-phosphorus was not. This may be related to uncertainties in the crthophosphate dissolution step of the analytical method which was based, rather arbitrarily, upon leaching with dilute acid following a standard soil test method (17). Many of the cadmium values measured were near the detection limit of the method and were, therefore, subject to considerable percentage error. The predicted cadmium concentration of traffic-related depositions is only about 0.001%. Only 12 roadway samples were analyzed for polychlorinated biphenyls (PCB's). Additional analyses are required to determine with a fair degree of certainty whether or not a correlation exists between PCB's and traffic volume.

The remaining parameters in Table 14 are considered to be traffic dependent in light of the highly significant correlations shown. This is not to imply that these materials are directly emitted by motor vehicles. To the contrary, as has been mentioned previously, most of the traffic-related materials have origins other than with the motor vehicle itself. Speculations as to the sources of traffic-related pollutants will be discussed in a later report section. Some geographic variations in the deposition rates of traffic-related materials are anticipated since much of this material is representative of the local geology. However, it is believed that most of the rates will be uniformly applicable. Greatest variations will be found in depositions of volatile solids, BOD, COD, phosphorus, nitrogen, chloride and the magnetic fraction. Deposition rates of total dust and dirt and those materials originating directly from the motor vehicle are expected to remain constant. Other pollutants not found in the Washington, D.C. Metropolitan area may appear to be traffic related in certain areas of the country depending upon their presence in local soils.

TABLE 14. DEPOSITION RATES OF ROADWAY MATERIALS[a]

Parameter	Deposition Rate (lbs./axle-mile)	Significance of Correlation (%)
Dry Weight	2.38×10^{-3}	<0.1
Volume	6.33×10^{-4} (quarts)	<0.1
Volatile Solids	1.21×10^{-4}	<0.1
BOD	5.43×10^{-6}	<0.1
COD	1.28×10^{-4}	<0.1
Grease	1.52×10^{-5}	<0.1
Total Phosphate-P	1.44×10^{-6}	<0.1
Orthophosphate-P	4.31×10^{-8}	10
Nitrate-N	1.89×10^{-7}	<0.1
Nitrite-N	2.26×10^{-8}	<0.1
Kjeldahl-N	3.72×10^{-7}	<2
Chloride	2.20×10^{-6}	<0.1
Petroleum	8.52×10^{-6}	<0.1
n-Paraffins	5.99×10^{-6}	<0.1
Asbestos	$3.86 \times 10^{+5}$ (fibers)	<0.1
Rubber	1.24×10^{-5}	<0.1
Fecal Coliform	$-1.00 \times 10^{+3}$ (organisms)	>10
Fecal Strep	$-3.31 \times 10^{+2}$ (organisms)	>10
Lead	2.79×10^{-5}	<0.1
Chromium	1.85×10^{-7}	<1
Copper	2.84×10^{-7}	<1
Nickel	4.40×10^{-7}	<0.1
Zinc	3.50×10^{-6}	<0.1
Cadmium	3.11×10^{-8}	>10
Magnetic Fraction	1.26×10^{-4}	<1
Polychlorinated Biphenyls	1.0×10^{-9}	>10
Litter Dry Weight	1.69×10^{-4}	> 5
Litter Volume	1.72×10^{-5} (quarts)	>10
Litter Volatile Solids	-2.64×10^{-5}	>10
Litter BOD	3.49×10^{-7}	>10
Litter COD	-4.58×10^{-5}	>10

(a) Deposition of parameters has been arbitrarily assumed to be traffic dependent if the significance of the correlation is less than 2%.

The experimental design of the program and mathematical techniques employed have served to minimize contributions of fallout of air pollutants, other land use activities and traffic-related removal of roadway deposits to the deposition rates of traffic-related materials.

SEASONAL VARIATIONS IN POLLUTANT LOADINGS

The sampling schedule for the 12-month field study was designed so that each of the roadways would be studied several times during the year in order that seasonal variations of pollutant loadings could be investigated. A total of 15 parameters were selected for examination, one from litter and 14 from total dust and dirt, from among the traffic dependent and independent pollutants. Inspection of Table 15 on pollutants not related to traffic reveals no clear seasonal trend in the average pounds per mile of litter which accumulates on the roadways during a 24-hour period. However, the densities of microorganisms found in total dust and dirt undergo a definite seasonal pattern. Fecal coliform organisms were found in greatest numbers at all sites during the summer sampling periods. The fall loadings of coliforms were next in magnitude with very much lower levels found in the winter and spring seasons. Fecal streptococci were found to be more uniformly spread over the year than the coliforms; however, loadings were generally higher in the summer.

Examination of variations in depositions of traffic-related pollutants listed in Table 16 reveals a rather distinct seasonal pattern in which summer and fall depositions are generally higher than those in winter and spring. Note that the values in Table 16 are not to be construed as traffic-related deposition rates, although expressed in terms of loadings per axle, since these figures include contributions from sources other than motor vehicles. Deposition of dry weight of total dust and dirt is fairly uniform throughout the year with only slightly higher levels during the summer and fall. On the other hand, volatile solids, BOD and COD, are deposited at substantially higher levels during the summer and fall seasons. This is probably the result of greater amounts of vegetation during these seasons. Depositions of grease and its petroleum and n-paraffin fractions occur evenly with no distinct seasonal pattern. The seasonal deposition pattern expected for chloride was not observed due to the extremely mild winter conditions during which only minor amounts of salts and abrasives were spread on area roadways. Chloride deposition was generally highest in fall and uniformly at its lowest level in the spring. The nitrate and total kjeldahl nitrogen patterns were not as clear cut; however, nitrate depositions tended to be highest in spring and lowest in the fall. Kjeldahl nitrogen tended to be highest in summer and lowest during winter, again probably related to the amounts of plant materials extant. A most unexpected observation was the disproportionately high deposition of lead and zinc during the summer and fall seasons which was several times higher than during winter and spring. Copper and nickel depositions, not shown in Table 16, were fairly uniform throughout the year. Seasonal data from three roadway sites indicate that rubber wear is highest during summer. This may account for

TABLE 15. SEASONAL VARIATIONS IN LOADINGS OF NONTRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter			Spring			Summer			Fall		
	Litter lbs/mi	Fec. Col. million org/mi.	Fec. Strep. million org/mi.	Litter lbs/mi	Fec. Col. million org/mi.	Fec. Strep. million org/mi.	Litter lbs/mi.	Fec. Col. million org/mi.	Fec. Strep. million org/mi.	Litter lbs/mi	Fec. Col. million org/mi.	Fec. Strep million org/mi.
Kenilworth Av. Low Spd. Lane	54.6	0	149.7	48.2	13.2	0.4	111.4	723.9	0.7	35.2	424.4	10.7
Kenilworth Av. High Spd. Lane	49.8	0	16.3	61.8	0	6.1	201.4	163.9	47.6	73.4	0	0.8
I 495	55.6	1.9	15.5	48.8	0.7	8.1	31.2	24.1	20.1	45.4	26.3	605.3
CAMP Station	61.4	0	2.2	48.8	0	96.1	46.4	1785.2	66.9	82.8	32.7	29.1
N. Capitol St. Low Spd. Lane	32.2	139.0	20.9	226.2	8.9	91.4	48.8	1689.9	2519.9	27.0	6.6	25.9

(a) Data given are average seasonal loadings calculated from samples deposited over a 24-hour period.

TABLE 16. SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	Dry Wt. lbs/ ax-mi. x 10^{-3}	Vol. Sol. lbs/ ax-mi. x 10^{-3}	Dry Wt. lbs/ ax-mi. x 10^{-3}	Vol. Sol. lbs/ ax-mi. x 10^{-3}	Dry Wt. lbs/ ax-mi. x 10^{-3}	Vol. Sol. lbs/ ax-mi. x 10^{-3}	Dry Wt. lbs/ ax-mi. x 10^{-3}	Vol. Sol. lbs/ ax-mi. x 10^{-3}
Kenilworth Av. Low Spd. Lane	1.01	0.090	1.13	0.083	2.10	0.229	1.12	0.139
Kenilworth Av. High Spd. Lane	2.11	0.116	2.32	0.105	6.43	0.386	3.10	0.168
I 495	6.86	0.283	3.47	0.175	3.79	0.310	5.47	0.378
CAMP Station	34.66	1.855	22.12	1.237	35.50	2.005	36.82	3.041
N. Capitol St. Low Spd. Lane	3.01	0.210	5.33	0.276	3.45	0.242	3.37	0.386

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	BOD lbs/ ax-mi. x 10^{-6}	COD lbs/ ax-mi. x 10^{-6}	BOD lbs/ ax-mi. x 10^{-6}	COD lbs/ ax-mi. x 10^{-6}	BOD lbs/ ax-mi. x 10^{-6}	COD lbs/ ax-mi. x 10^{-6}	BOD lbs/ ax-mi. x 10^{-6}	COD lbs/ ax-mi. x 10^{-6}
Kenilworth Av. Low Spd. Lane	3.8	84	6.5	85	9.9	204	7.7	124
Kenilworth Av. High Spd. Lane	7.4	150	7.0	172	12.4	686	12.8	240
I 495	13.2	362	8.5	238	11.0	364	15.3	360
CAMP Station	95.6	3033	74.9	2038	71.8	3379	277.3	6712
N. Capitol St. Low Spd. Lane	17.2	346	26.2	455	15.8	389	28.2	352

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	Grease lbs/ ax-mi. x 10^{-6}	Chloride lbs/ ax-mi. x 10^{-6}	Grease lbs/ ax-mi. x 10^{-6}	Chloride lbs/ ax-mi. x 10^{-6}	Grease lbs/ ax-mi. x 10^{-6}	Chloride lbs/ ax-mi. x 10^{-6}	Grease lbs/ ax-mi. x 10^{-6}	Chloride lbs/ ax-mi. x 10^{-6}
Kenilworth Av. Low Spd. Lane	13	3.0	29	0.3	21	1.5	15	4.5
Kenilworth Av. High Spd. Lane	21	3.1	21	0.9	68	1.9	25	1.0
I 495	42	4.3	28	2.3	43	3.3	45	8.0
CAMP Station	384	7.9	287	6.4	406	16.0	589	24.6
N. Capitol St. Low Spd. Lane	70	1.3	56	1.0	44	3.0	46	5.0

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	Petrol. lbs/ ax-mi. $\times 10^{-6}$	n-Par. lbs/ ax-mi. $\times 10^{-6}$	Petrol. lbs/ ax-mi. $\times 10^{-6}$	n-Par. lbs/ ax-mi. $\times 10^{-6}$	Petrol. lbs/ ax-mi. $\times 10^{-6}$	n-Par. lbs/ ax-mi. $\times 10^{-6}$	Petrol. lbs/ ax-mi. $\times 10^{-6}$	n-Par. lbs/ ax-mi. $\times 10^{-6}$
Kenilworth Av. Low Spd. Lane	9	6	8	7	9	7	7	4
Kenilworth Av. High Spd. Lane	13	10	14	12	23	21	11	9
I 495	29	24	17	12	21	17	23	16
CAMP Station	209	165	138	128	226	194	156	178
N. Capitol St. Low Spd. Lane	37	30	31	22	26	21	26	19

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	NO_3-N	TKN	NO_3-N	TKN	NO_3-N	TKN	NO_3-N	TKN
	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}
Kenilworth Av. Low Spd. Lane	0.079	0.74	0.242	1.29	0.269	2.20	0.230	0.84
Kenilworth Av. High Spd. Lane	0.098	1.06	0.470	1.93	0.083	3.71	0.131	0.78
I 495	0.284	0.67	0.360	1.35	0.334	1.89	0.251	2.01
CAMP Station	3.337	17.80	1.830	20.28	2.830	23.56	1.036	31.50
N. Capitol St. Low Spd. Lane	0.468	3.58	0.313	2.93	0.192	3.23	0.254	1.12

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[a]

Roadway Site	Winter		Spring		Summer		Fall	
	Lead	Zinc	Lead	Zinc	Lead	Zinc	Lead	Zinc
	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$	lbs/ ax-mi. $\times 10^{-6}$
Kenilworth Av. Low Spd. Lane	3.01	0.95	1.57	0.58	7.12	6.41	5.16	2.06
Kenilworth Av. High Spd. Lane	4.15	1.98	13.69	1.18	30.29	9.90	18.94	3.83
I 495	35.04	2.90	28.39	3.68	58.94	9.31	77.59	6.36
CAMP Station	32.29	10.44	27.09	7.61	87.42	23.66	40.46	18.10
N. Capitol St. Low Spd. Lane	3.47	2.23	12.48	2.89	10.02	2.51	8.56	6.93

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

TABLE 16 (CONTINUED). SEASONAL VARIATIONS IN LOADINGS OF TRAFFIC-RELATED POLLUTANTS ON ROADWAYS[(a)]

Roadway Site	Winter		Spring		Summer		Fall	
	Asbsts fbs/ ax-mi. $\times 10^{+3}$	Rubber lbs/ ax-mi. $\times 10^{-6}$	Asbsts fbs/ ax-mi. $\times 10^{+3}$	Rubber lbs/ ax-mi. $\times 10^{-6}$	Asbsts fbs/ ax-mi. $\times 10^{+3}$	Rubber lbs/ ax-mi. $\times 10^{-6}$	Asbsts fbs/ ax-mi. $\times 10^{+3}$	Rubber lbs/ ax-mi. $\times 10^{-6}$
Kenilworth Av. Low Spd. Lane	81	7.8	57	2.1	22	13.4	26	2.8
Kenilworth Av. High Spd. Lane	69	5.3	144	4.3	43	27.5	56	16.8
I 495	733	17.7	143	6.1	106	24.8	1330	23.9
CAMP Station	1957	93.3	-	44.3	-	-	2968	74.9
N. Capitol St. Low Spd. Lane	345	14.8	171	8.3	-	-	365	23.8

(a) Data given are average seasonal per axle loadings of total dust and dirt parameters. Loadings of individual samples in pounds per mile (fibers per mile in the case of asbestos) were divided by traffic in axles and the results averaged for each season. Average seasonal values shown are to be multiplied by the power of ten shown under the units, that is, a tabulated dry weight value of 1.01 equals 0.00101 pounds per axle mile and an asbestos value of 81 equals 81,000 fibers per axle-mile.

some of the seasonal increases in lead and zinc depositions since oxides of these metals are used as fillers in the manufacture of tires. Seasonal lead depositions from combustion of leaded fuels would not be expected to vary in such a dramatic fashion. Motor oil leaks, another potential source of lead and zinc, do not vary seasonably as indicated by the relative constancy of grease and grease fraction depositions. Limited seasonal data from three of the five roadway sites indicates that brake and clutch wear is higher in winter and lower in summer as evidenced by asbestos deposition in total dust and dirt.

CONTRIBUTIONS FROM LAND USE ACTIVITIES

It has been stated previously that the central concern of this project has been the investigation of traffic-related phenomena leading to depositions of pollutants on urban roadways. Thus, the roadway sites studied were, for the most part, selected on the basis of minimal interference from urban land use activities. This placed considerable limitations on the study of other land use effects. However, the two roadway sites in commercially zoned areas, Loehmann's Plaza Shopping Center and the CAMP Station at New Jersey Avenue and E Street, N.W., received considerable contributions from associated land use activities. Results of nontraffic contributions at the CAMP Station site, principally from heavy construction on the opposite side of New Jersey Avenue, are readily apparent in Table 16, which was prepared to show seasonal variations in deposition of roadway materials. Table 17 contains average loadings for selected litter and total dust and dirt parameters at each of the roadway sites and is intended to show typical patterns in the loadings. It is immediately obvious that the per axle loadings of total dust and dirt parameters at the CAMP Station and shopping center sites were approximately one order of magnitude higher than at the others. Based upon the total dust and dirt dry weight deposition rate given in Table 14, the observed loadings at the CAMP Station and Loehmann's Plaza sites would be expected with ADT's of 79,500 and 31,300 axles, respectively. Petroleum, rubber and zinc were selected over other total dust and dirt parameters for inclusion in Table 17 as it was felt that these depositions might have their origins more completely with traffic-related phenomenon and thus be independent of other land use activities. Inspection of this table reveals that this assumption was not justified. Rather surprisingly, the litter loadings observed at these sites were not any higher than at sites receiving principally traffic-related deposits. In fact, litter loadings at the Loehmann's Plaza Shopping Center averaged lower than all but one of the other roadway sites. Much of the shopping center litter consisted of low bulk density materials such as tobacco and paper products contributed by pedestrians. The majority of the nontraffic-related depositions were smaller particles of soil and humus from planters within the shopping center and sweepings of the paved mall. Contributions of nontraffic land use activities at these two sites resulted in high dust and dirt loadings, but did not substantially increase loadings of larger sized litter particles.

TABLE 17. LAND USE EFFECTS ON DEPOSITION OF ROADWAY MATERIALS[(a)]

Roadway Site	Zoning	Avg. Daily Traffic (axles)	Litter Weight lbs/ mi-day	Dry Weight lbs/ ax-mi. x 10^{-3}	Petrol. lbs/ ax-mi. x 10^{-6}	Rubber lbs/ ax-mi. x 10^{-6}	Zinc lbs/ ax-mi. x 10^{-6}	Chloride lbs/ ax-mi. x 10^{-6}
CAMP Station	C-3-B	5,800	62.67	32.62	209	71.8	14.94	14.8
Loehmann's Plaza Shopping Center	C-1	2,600	10.47	28.67	201	149.0	37.43	12.5
N. Capitol St. Low Spd. Lane	R-3	40,000	67.64	3.57	30	15.6	3.65	2.8
N. Capitol St. High Spd. Lane	R-3	40,000	13.28	2.62	25	15.5	1.67	0.9
Balto.-Wash. Pkwy.	R-18	73,000	44.54	0.88	9	2.8	0.65	2.0
Kenilworth Ave. Low Spd. Lane	R-1-B	83,000	62.68	1.36	8	6.5	2.70	2.5
Kenilworth Ave. High Spd. Lane	R-1-B	83,000	95.64	3.59	16	13.4	4.54	2.0
I 495	R-60	109,000	46.46	5.19	23	18.1	5.56	4.8
I 95 Unopened Section	R-R	0	0.09	-	-	-	-	-

(a) Data given are average litter loadings and per axle loadings of selected total dust and dirt parameters. Average values shown are to be multiplied by ten to the power shown under the units, that is, a tabulated dry weight value of 32.62 equals 0.03262 pounds per axle-mile and a rubber value of 149.0 equals 0.000149 pounds per axle-mile.

The site on Interstate Route 95 received the lowest average deposits of litter. This site was not opened to traffic at the time of this study and was located in a rural area isolated by fencing, woods and considerable distance from man-made land use activities. Loadings found on the Interstate Route 95 site would be expected with an ADT of about 500 based upon the total dust and dirt dry weight deposition rate given in Table 14. Most of the total dust and dirt collected at this site resulted from dusting and abrasion during sampling of the newly formed concrete roadway surface. Contribution from this source would be much lower on a roadway which had been in use for some time.

Thus, for the nine roadways studied, one received extremely low deposition of litter and dust and dirt, six sites received depositions principally related to motor vehicular traffic and two of the sites received depositions due mostly to associated land use activities unrelated to traffic.

CURB HEIGHT EFFECTS

After the field study had been in progress long enough to gather a cross section of data from all of the roadways, certain trends became apparent upon examination of loadings from the six sites receiving deposits principally of traffic-related materials. Some unexpected findings were observed in the distribution of litter and dust and dirt at the sites along opposite sides of southbound Kenilworth Avenue. Rather than the anticipated equal distribution along the sides of the roadway, the average amount of low-speed lane total dust and dirt was only 28% of the total amount collected from both sides. Amounts of litter associated with these same samples indicated a more even distribution with an average of 40% of the total occurring along the low-speed lane. A special winter sampling program was conducted at sites on the high-speed and low-speed lanes of North Capitol Street in an attempt to explain the observed unequal distributions of roadway materials. The total dust and dirt from the low-speed lane of North Capitol Street was found to be nearly the same, 53% of the total collected, as from along the high-speed lane. This lead to accumulation of data in the form presented graphically in Figure 7. Inspection of the figure reveals that the per axle total dust and dirt dry weight loadings are strongly influenced by the height of the curb or other roadway barrier along which samples were accumulated. Height appears to influence dust and dirt loadings up to about 15 to 20 inches while, as might be expected, litter loadings did not appear to be influenced. These data indicate that significant amounts of dust and dirt become airborne and are carried over curbs to settle on areas adjacent to the roadways. This phenomenon would result in differences in composition of materials collected along barriers of differing heights as larger amounts of smaller particles, which differ considerably from the composition of the bulk sample, would be lost from along the lower barriers.

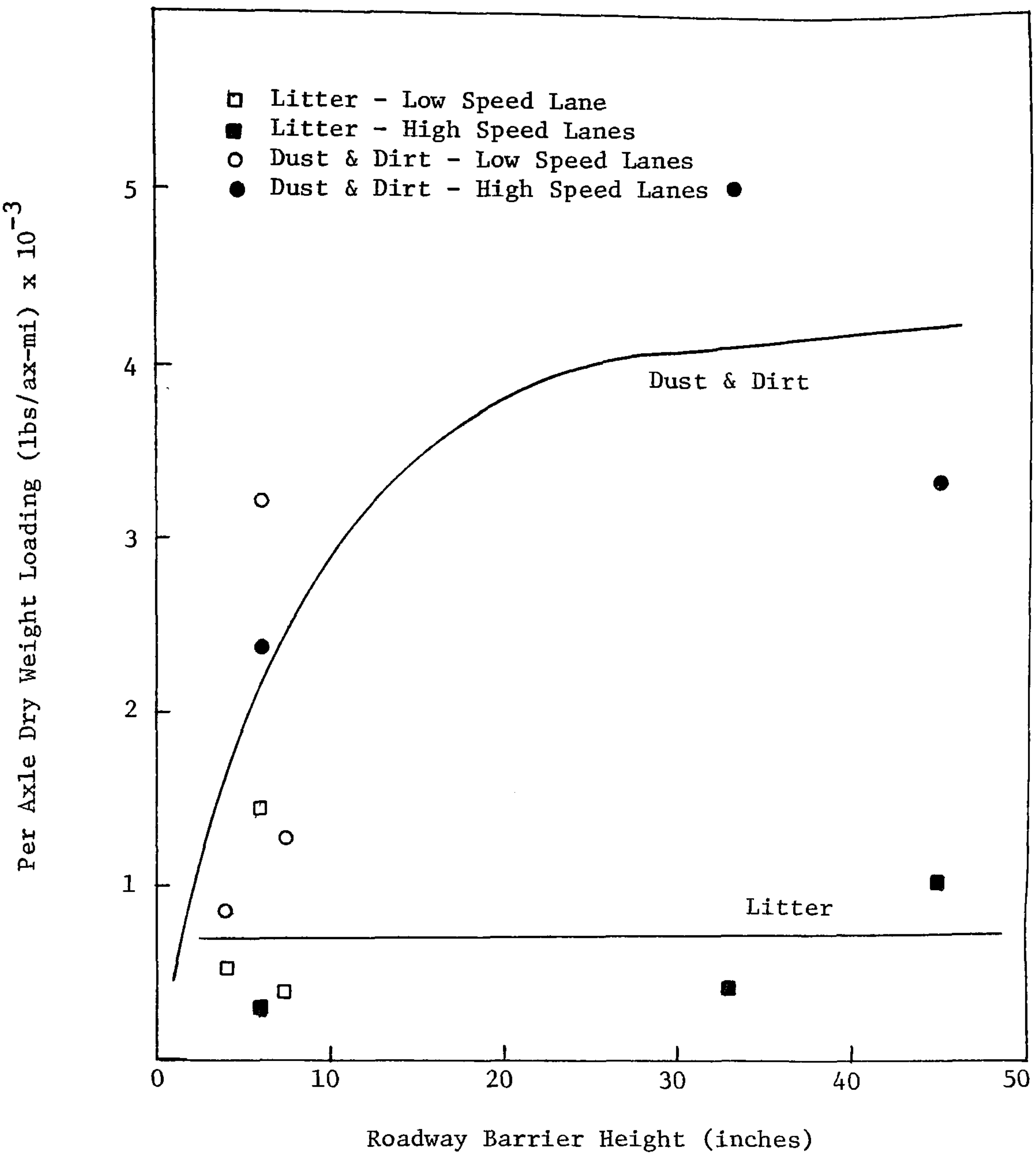


Figure 7. Per axle dry weight loading vs. roadway barrier height[a]

(a) Average per axle amounts of litter and total dust and dirt dry weight collected at each of the sites receiving principally traffic-related deposits have been plotted versus height of the curb or other roadway barrier against which samples were collected.

This effect of barrier height upon the dry weight of total dust and dirt collected represents a significant finding in terms of the consequences of street and highway construction.

OTHER FACTORS INFLUENCING DEPOSITION OF ROADWAY MATERIALS

The random nature of roadway material deposition mechanisms limits the accuracy that can be attained in this type of study. Replicate determinations of depositions occurring on adjacent roadway sections revealed a relative standard deviation of about 25% for litter and for dust and dirt dry weight. This factor, coupled with physical differences in the sites, makes it difficult to detect subtle influences on traffic-related deposition rates. Contributions from other land use activities, seasonal variations in deposition rates, and the effects of roadway barrier heights previously discussed tend further to obscure differences resulting from such factors as roadway materials of construction, average vehicular speed and traffic mix. The bar graphs in Figure 8 show average values for selected dust and dirt parameters at each of the roadway sites. The roadway sites have been arbitrarily arranged along the abscissa in order of increasing 85th percentile speed (see Table 8). However, no readily discernible relationship is observed. Additional averages of total dust and dirt parameters are given in Tables 17 and 18. A similar pattern in per axle loadings was observed with most parameters, apparently unrelated to speed. The overriding contributions of nontraffic-related land use activities at the CAMP Station and shopping center preclude detection of traffic-related phenomena at these sites. Data obtained from the remaining six roadway sites, receiving predominantly traffic-related depositions, also showed no pattern which was readily relatable to speed. Likewise, no effects were observed which could be attributed to differences in roadway surface material. Roadway surfaces at Loehmann's Plaza Shopping Center, the CAMP Station and North Capitol Street were constructed from asphalt. The Interstate Route 495 site had an asphalt shoulder and a concrete roadway surface. All of the other sites were paved solely with concrete. Grease and its petroleum and n-paraffin fractions were about one order of magnitude higher in asphalt paving than in concrete. Nickel content was four to five times higher in asphalt. None of these parameters appeared at significantly higher levels in depositions from sites paved with asphalt (see Table 17 and 18).

Another of the objectives of the study was to investigate effects of differing traffic mixes on roadway deposition rates. To this end, total traffic was broken down into five classifications during each of the roadway site sampling periods (see Table A-3 in Appendix A). Average traffic mixes observed at the sites are given in Table 19. Automobiles range only from 78 to 92% while totals of the three truck categories vary between 8 and 22%. Maximum bus traffic is only 2.5%. This is insufficient leverage and, coupled with the other factors discussed previously, makes it difficult to draw positive conclusions regarding effects of traffic mix on deposition of roadway materials.

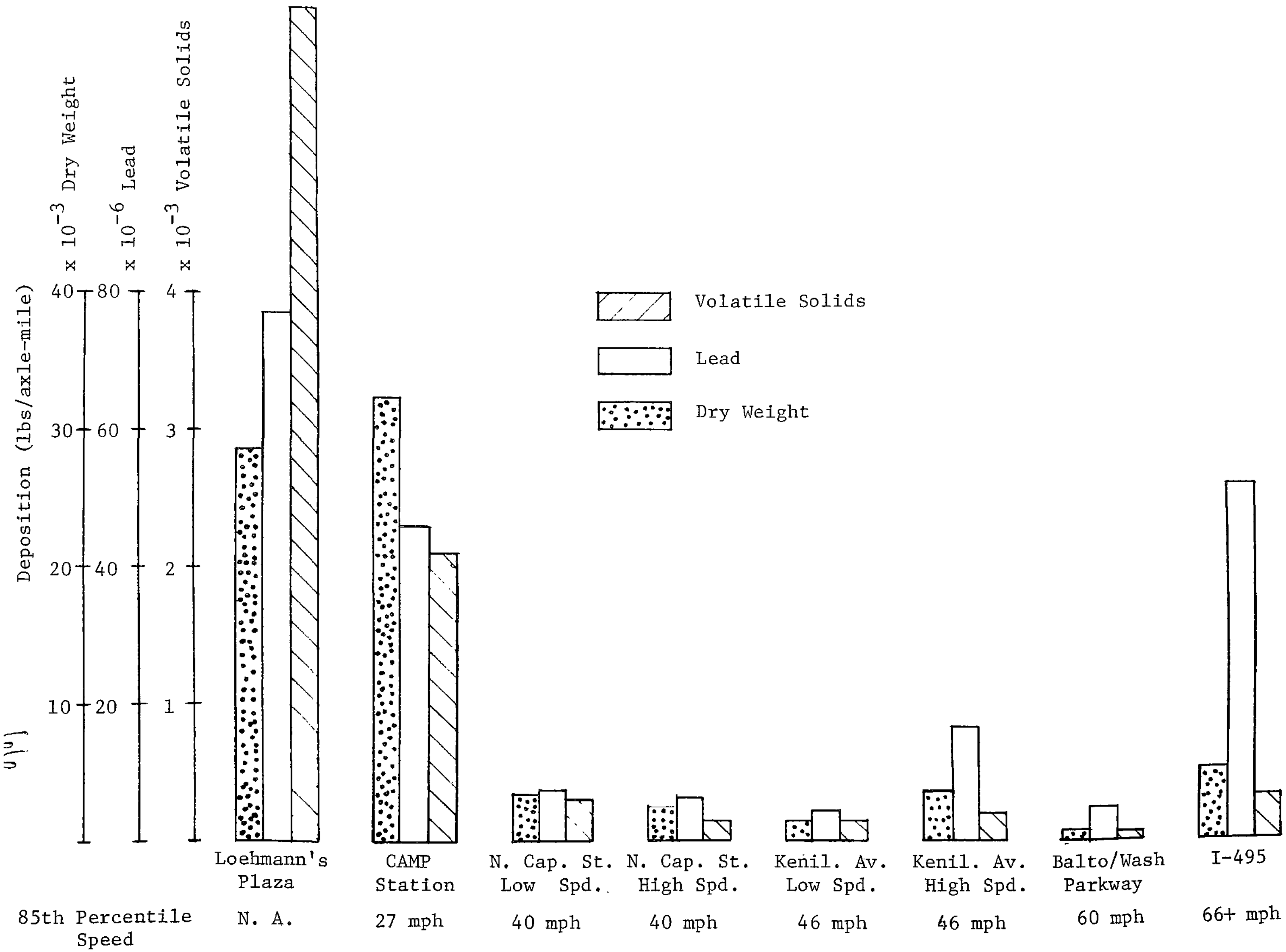


Figure 8. Effects of traffic speed upon deposition of roadway materials

TABLE 18. DEPOSITION OF TOTAL DUST AND DIRT PARAMETERS[(a)]

Roadway Site	Volatile Solids	BOD	COD	Grease	NO_3-N	TKN	n-Paraffins	Asbestos	Coliform	Fecal Strep.	Lead	Copper	Nickel
	lbs/ ax-mi. x 10^{-3}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	fbs/ ax-mi. x 10^{+3}	million org/ mi-day	million org/ mi-day	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}	lbs/ ax-mi. x 10^{-6}
CAMP Station	2.112	142.2	4,015	430		23.92	167	2,535	457.2	43.0	46.33	2.164	3.375
Loehmann's Plaza Shopping Center	6.077	290.8	5,964	528	2.148	39.20	127	1,993	0	75.2	77.00	1.693	3.328
North Capitol St. Low Spd. Lane	0.292	21.2	375	54	0.306	2.68	23	318	538.5	768.2	7.72	0.179	0.312
North Capitol St. High Spd. Lane	0.154	7.6	283	44	0.284	1.86	20	171	0	86.6	6.48	0.103	0.269
Balto.-Wash. Pkwy.	0.071	5.8	97	14	0.231	1.22	7	104	3,165.4	40.4	4.42	0.046	0.70
Kenilworth Ave. Low Spd. Lane	0.139	6.8	128	18	0.189	1.26	6	50	280.3	53.0	4.07	0.161	0.217
Kenilworth Ave. High Spd. Lane	0.203	10.6	326	35	0.154	1.88	13	64	41.0	18.6	16.15	0.210	0.383
I 495	0.298	12.2	340	41	0.299	2.08	18	657	13.5	184.0	52.00	0.399	0.799

(a) Data given are average daily loadings of microorganisms and per axle loadings of selected total dust and dirt parameters. Average values shown are to be multiplied by ten to the power shown under the units, that is, a tabulated COD value of 97 equals 0.000097 pounds per axle-mile and an asbestos value of 50 equals 50,000 fibers per mile day.

TABLE 19. AVERAGE BREAKDOWN OF TOTAL TRAFFIC AT ROADWAY SITES

Roadway Site	Average Traffic Breakdown (%)				
	Autos	Buses	Panel & Pickup Trucks	Single Unit Trucks	Semi-Tractor & Trailer
Interstate 95	No Traffic				
Loehmann's Plaza Shopping Center	92.2	0	4.8	2.2	0.8
CAMP Station, New Jersey Ave. & E. St., N.W.	82.8	1.0	7.9	6.9	1.4
N. Capitol St., N.E.	86.7	1.4	5.7	5.2	1.0
Balto.-Wash. Parkway	91.8	2.5	5.5	0.2	0.0
Kenilworth Ave.	85.3	0.6	7.8	5.0	1.3
Interstate 495, Capitol Beltway	78.4	0.3	9.6	6.6	5.1

SECTION VI

SPECIAL STUDIES

ORIGIN OF POLLUTANTS FOUND IN ROADWAY MATERIALS

The composition of total dust and dirt being deposited on roadways via traffic-related mechanisms is given in Table 20. These values have been calculated based upon the deposition rates given in Table 14. This material is over 95% inorganic and has a bulk density of 1.6 grams per cubic centimeter. A litter fraction is associated with the dust and dirt. The weight of this former fraction is approximately 20% that of the total dust and dirt fraction. It has been determined in previous studies that most of the deposited materials are derived from surrounding land areas and do not originate with the motor vehicle or street surface material (11). Results from the current investigation tend to substantiate this observation. Considerable efforts were expended in collection and laboratory analysis of so-called "pure" substances in order to obtain additional information on the origins of street surface contaminants. These data, given in Table 21, are from samples of compounds and fluids used in motor vehicles, roadway paving materials, soil from the Metropolitan area, roadway abrasives and deicing compounds. Cigarettes were included with the group of "pures" as an afterthought upon observation of large numbers of tobacco product remnants in the litter fractions of roadway deposited materials.

The volatile solids of total dust and dirt include the organic constituents; rubber, protein, grease and its petroleum and n-paraffin fractions, and other unclassified organics. Inorganic carbonates constitute a considerable portion of the volatile solids as evidenced by the vigorous evolution of carbon dioxide that generally occurred when dust and dirt samples from the Washington, D.C. area were acidified prior to analysis. The rubber found is a result of tire wear and the total kjeldahl nitrogen most probably is derived from plant protein materials. Grease consists primarily of fatty acids, fats, plant waxes and oils and hydrocarbons of petroleum origin. The petroleum fraction of grease contains the petroleum derived hydrocarbons, with the exception of certain polar aromatic and substituted hydrocarbon compounds. Therefore, the difference between grease and its hydrocarbon fraction is an estimate of fatty matter of plant and animal origin. The hydrocarbon fraction originates from drippings and leaks of motor vehicle lubricants and hydraulic fluids as well as from crankcase and less volatile engine exhaust products.

The high COD to BOD ratios observed in stormwater runoff from urban areas or roadway surface contaminants have generally been attributed to toxicity of heavy metals present in such samples. However, other possibilities exist. Rubber, petroleum compounds, fatty substances and plant cellulosic materials are resistant to biological oxidation and are not usually completely biodegraded during the normal five-day period of the BOD determination. The COD contributed by 0.52% rubber and 0.64% grease, assuming

2.1 g COD per gram of rubber and 0.64 g COD per gram of grease, still leaves 3.9% COD unaccounted for in the total dust and dirt. Less than 0.1% of this is attributable to the COD of proteinaceous materials. Much of the COD unaccounted for may be from inorganic oxygen demanding substances. The large magnetic fraction of 5.3% suggests that considerable amounts of ferrous iron may be present in the roadway deposits. This is a difficulty soluble form of iron which will contribute to COD but not to BOD. Magnetite, a magnetic oxide containing ferrous iron, has been identified in roadway dust and dirt. The magnetic fraction originates from area soils which contain magnetic iron compounds. In addition, some magnetic materials are deposited as a result of corrosion of motor vehicle bodies, engines and exhaust systems.

The chloride content of dust and dirt was found to be traffic dependent, that is, a function of the numbers of vehicles traveling the roadway.

TABLE 20. CALCULATED COMPOSITION OF TRAFFIC-RELATED ROADWAY DEPOSITIONS[(a)]
(WASHINGTON, D.C. METROPOLITAN AREA)

Parameter	Percentage Composition (Unless Otherwise Stated)
Bulk Density	1.5 (grams/cc)
Volatile Solids	5.1
BOD	0.23
COD	5.4
Grease	0.64
Total Phosphate-P	0.061
Total Nitrogen	0.025
Chloride	0.092
Petroleum	0.36
n-Paraffins	0.25
Rubber	0.52
Lead	1.2
Chromium	0.008
Copper	0.012
Nickel	0.019
Magnetic Fraction	5.3
Asbestos	3.6×10^5 (fibers/gram)

(a) The percentage composition, by weight, has been calculated based upon deposition rates shown in Table 14. For example:

$$\frac{5.43 \times 10^{-6} \text{ lbs. BOD/axle-mile}}{2.37 \times 10^{-3} \text{ lbs. Dry Wt./axle-mile}} \times 100 = 0.23\% \text{ BOD}$$

TABLE 21. ANALYSIS OF "PURE" MATERIALS - PART I

Material	Tot. Vol. Solids (mg/g)	BOD[(a)] (mg/g)	COD (mg/g)	Grease (mg/g)	Petroleum (mg/g)	n-Paraffins (mg/g)
Gasoline	999.5	154.0	682.1	1.3	1.3	1.3
Lubricating Grease	973.9	143.3		753.1	665.8	566.3
Motor Oil	996.9	143.8	220.8	989.2	937.7	850.0
Transmission Fluid	999.8	102.6	198.3	985.6	941.7	875.4
Antifreeze	987.8	37.6	1102.4	143.8	69.6	6.1
Undercoating	998.7	89.8	309.5	958.1	182.8	120.7
Asphalt Pavement	64.2	1.2	85.5	21.4	15.0	9.0
Concrete	70.7	1.4	63.6	2.7	1.3	1.0
Rubber	986.3	26.8	2097.4	191.6	97.8	56.0
Diesel Fuel	999.9	80.2	399.0	385.3	307.8	209.7
Brake Linings	285.3	16.9	416.5	30.5	8.3	7.6
Brake Fluid	999.8	25.8	2420.8	883.0	33.1	18.6
Cigarettes	862.2	85.4	776.8	30.0	21.2	2.7
Salt (b)	74.7	-	-	0.0	0.0	0.0
Cinders	0.0	-	59.3	1.3	1.2	1.2
Area Soil (c)	-	-	-	-	-	-

(a) BOD determinations were made on "pure" materials using a seed of unacclimated sewage organisms.

(b) Results are on a dry weight basis. Salt as received contained 3.7% water, assayed 93.2% sodium chloride, and contained less than 0.005% cyanide.

(c) Soils from the Washington, D.C. area contained a magnetic fraction of from 8.9 to 12.5%, less thar 0.05 mg rubber per gram, less than 3 x 10^5 asbestos fibers per gram, 50 to 100 mg/g volatile solids and 15 to 80 mg/g COD.

TABLE 21 (CONTINUED). ANALYSIS OF "PURE" MATERIALS - PART II

Material	Metals Content (μg/g)					
	Lead	Mercury	Chromium	Copper	Nickel	Zinc
Gasoline	663	0	15	4	10	10
Lubricating Grease	0	0	0	0	0	164
Motor Oil	9	0	0	3	17	1060
Transmission Fluid	8	0	0	0	21	244
Antifreeze	6	0	0	76	16	14
Undercoating	116	0	0	0	476	108
Asphalt Pavement	102	0	357	51	1170	164
Concrete	450	0	93	99	264	417
Rubber	1110	0	182	247	174	617
Diesel Fuel	12	0	15	8	8	12
Brake Linings	1050	0	2200	30600	7454	124
Brake Fluid	7	0	19	5	31	15
Cigarettes	492	0	71	716	193	560
Salt	2	0	2	2	9	1
Cinders	0	0	0	3	4	7
Area Soil	0	0	36	23	25	27
Detection Limit	2	0.05	2	1	1	0.01

Therefore, the levels observed in this study do not result from application of highway deicing compounds. The low levels of chlorides and phosphate found probably originate with area soils, abraded roadway surface materials and, to a lesser extent, from plant and animal sources.

Much of the lead deposited on urban roadways resulted from combustion of leaded gasoline although some is deposited with leaking motor oil and transmission fluid. Combustion of leaded gasoline introduces considerable quantities of lead into engine oil and transmission fluid and motor oil becomes contaminated with wear metals, including lead from babbitt metal bearings. Other engine wear metals include:

- Copper - from wear of thrust bearings, bushings and bearing metals
- Chromium - from wear of metal plating, rocker arms, crankshafts and rings
- Zinc - this is an ingredient of oil addition
- Phosphorus - also an oil additive

Zinc, lead and other metallic oxides are used as fillers in the manufacture of rubber tires and are deposited on roadways as tires are abraded. High concentrations of organozinc compounds are used as stabilizing additives in motor oils. Nickel and chromium abraded from roadway surface materials and from the corrosion of steel motor vehicle parts contribute to the heavy metal load of street surface contaminants. Chromium is used for plating and is a wear metal found in motor oils. Both nickel and chromium are present in brake lining materials. Asbestos in dust and dirt is produced by abrasion of clutch plates and brake linings. Copper wire is added to brake linings for increased mechanical strength and to provide better heat transfer properties. Brake linings contain large amounts of copper, over 3% in the particular lining analyzed, and it is probable that much of the copper deposits originate from this source. Calculation of copper emissions from brake lining wear yields a value approximately one order of magnitude higher than the deposition rate given in Table 14. This tends to support the Bendix Research Laboratories finding that much of the products of break wear are retained by the motor vehicle (9). Heavy metal analyses of area soils demonstrate that significant quantities of these elements, with the possible exception of chromium, did not originate from this source.

It has been stated earlier in this report that loadings of PCB's did not appear to be traffic related based upon a limited number of sample analyses. However, if it were assumed that PCB's were deposited via traffic-related mechanisms and if the deposition rate calculated in Table 14 were accurate, total dust and dirt containing 0.5 ppm would result. The 12 dust and dirt samples actually analyzed ranged from a low of 0.05 to a high of 3.6 ppm PCB's. Until recently, PCB's were widely used in paints, printing inks, plasticizers and as transformer and capacitor fluids. Use of PCB's has been greatly curtailed during the past few years and the major application today is for dielectric fluids and some hydraulic fluids. It might be speculated that PCB's were and perhaps still are being dispersed throughout urban areas by incineration of plastic, paper and other PCB containing products. PCB's are nonflammable and would survive incineration. In any event, it is most probable that area soils are the immediate source of PCB's found in roadway materials.

EXAMINATION OF ROADWAY DUST AND DIRT

Street surface contaminants consist largely of roadway surfacing materials and various mineral forms representative of the local geology. Results from this study show that dust and dirt is composed of over 95% inorganic material, most of which is insoluble. Visual examinations of roadway samples conducted at 25 to 100 times magnification under dissecting and compound microscopes reveal many individual particles appearing to be fractured mineral crystals. Considerable quantities of an irregularly shaped transparent substance were found. This material was later identified as alpha-quartz. Samples also contained an iron bearing magnetic fraction amounting to about 5% by weight of the total dust and dirt. In the midst of all the irregularly shaped sample particles, two types of spherical particles were observed. Transparent, nonmagnetic, almost perfectly spherical particles containing pockets of gas, in some cases, were observed in most all of the roadway samples. These particles, which appeared to be formed from a melt, were later identified as silica. No clues as to the origin of the transparent spheres were uncovered. They are most likely not directly associated with motor vehicles as they were not observed in brake lining wear materials or in the tail pipes of several passenger automobiles inspected for this purpose. These particles did not appear in roadway samples collected by URS Research Company in their study of street surface contaminants. A second type of spherical particle was found only in samples taken at the CAMP Station site. These were opaque, magnetic, less perfectly formed spheres and were also reported in many of the samples studied by URS Research Company. The magnetic spheres were identified as iron oxides. It is believed that the spheres were produced by welding operations as part of subway and office building construction activities in progress near the CAMP Station site during the period of the sampling program. These particles have also been attributed to stationary sources burning fossil fuels.

Semiquantitative emission spectrographic analyses of eight dust and dirt samples were performed to determine the major metallic constituents of street surface contaminants found in this study area. These results are summarized in Table 22. Principal elements found were aluminum, calcium, iron, magnesium and silicon with lesser amounts of manganese, sodium, lead, titanium, zinc and zirconium. Trace amounts (less than

0.1%) of a number of other metallic elements were also found. The emission spectrographic analytical results generally coincide with the energy dispersive X-ray analyses reported in Table 23 along with X-ray diffraction results obtained on the same samples. The mineral magnetite, Fe_3O_4, contains ferrous and ferric iron and may be responsible for the high COD to BOD ratios as discussed in Section VI.

TABLE 22. SEMIQUANTITATIVE EMISSION SPECTROGRAPHIC ANALYSES OF ROADWAY DUST AND DIRT SAMPLES (WASHINGTON, D.C. METROPOLITAN AREA)

Element[(a)]	Concentration Range (b)
Aluminum	Medium-High
Boron	Trace
Barium	Trace
Calcium	Medium-High
Cobalt	Trace
Chromium	Trace
Copper	Trace
Iron	High
Magnesium	Medium-High
Manganese	Trace-Low
Molybdenum	n.d.-Trace
Sodium	Trace-Medium
Nickel	Trace
Lead	Low-Medium
Silicon	High
Tin	n.d.-Trace
Strontium	Trace
Titanium	Low
Vanadium	Trace
Zinc	Low
Zirconium	Trace-Low

ACCUMULATION OF STREET SURFACE CONTAMINANTS

The deposition of pollutants on roadways through traffic-related mechanisms occurs at a constant rate and is independent of loadings already present. However, the buildup or accumulation of street surface contaminants is not linear and levels off due to a combination of

(a) Other metallic elements were not detected.

(b) n.d. - not detected, trace less than 0.1%, low 0.1 - 1%, medium 1 - 10%, high 10 - 100%.

TABLE 23. ENERGY DISPERSIVE X-RAY AND X-RAY DIFFRACTION ANALYSIS OF ROADWAY DUST AND DIRT

Roadway Site	Sample Identification	Principal Compounds by Diffraction Analyses	Principal Elements by Energy Dispersive Analyses
Loehmann's Plaza	48D, nonmagnetic fraction	mostly α-quartz	Ca, Fe, Si, S, P
Loehmann's Plaza	48D, magnetic fraction	serpentine, $Mg_3Si_2O_5(OH)_4$ magnetite, Fe_3O_4 quartz, SiO_2	Fe, Si
CAMP	55D, nonmagnetic fraction	mostly α-quartz	Si
CAMP	55D, magnetic fraction	serpentine iron compounds quartz	Si, Fe, Pb
N. Capitol Street	59D, nonmagnetic fraction	not analyzed	Si, Fe
N. Capitol Street	59D, magnetic fraction	serpentine iron compounds quartz	Si, Fe
Kenilworth Avenue	69D, nonmagnetic fraction	quartz	Si
Kenilworth Avenue	69D, magnetic fraction	serpentine iron compounds quartz	Fe, Si
I 495	76D, nonmagnetic fraction	quartz	Si, Ca
I 495	76D, magnetic fraction	serpentine magnetite	Fe, Si, Pb
	Concrete	mostly quartz hydrated calcium silicate	Si, K, Ca
	transparent, non-magnetic, spherical particle	not analyzed	Si (nothing else)
CAMP	opaque, magnetic, spherical particle	not analyzed	Fe (nothing else)

factors, other than street cleaning or storm events. Information was sought concerning the linearity of accumulation through examination of data from the roadway samples.

Of the 127 roadway samples collected during the field study, data from 94 of these were used in calculations of traffic-related deposition rates. The remaining 33 samples were either collected after rainstorms or were initial samples for which no accurate traffic data was measured. Seventy-five of the 94 samples were collected after a one-day accumulation period; and, thus, the per axle deposition rates are most strongly influenced by these data. The other 19 samples used for rate determinations were gathered after either three or four days of accumulation on the roadways. Comparisons of loading intensities from samples having a one-day accumulation period with those having multiday accumulations periods revealed the magnitude of the leveling off of accumulation rates.

Inspection of the data in Table 24 demonstrates that the accumulated loadings have begun to level off within three to four days. Table 24 lists ratios of pollutant loadings calculated from daily samples to those from samples with accumulation periods of three to four days. Average values for each sampling period are given in order to eliminate seasonal influences on the ratios. The overall averages of the ratios are significantly lower than 3.13, demonstrating that accumulation of materials deposited on roadways is not linear, but levels off and approaches a maximum value. That is, the loadings after a three- or four-day accumulation period are significantly less than three or four times the loadings from samples with a one-day accumulation period. Note that averages of the ratios for each parameter are significantly lower than 3.13, but not significantly different from one another. This would indicate that accumulation of all parameters levels off at about the same rate. This knowledge is important in that it reflects the amounts of deposited material which will actually remain on the roadway and be available for collection by street cleaning operations. The accumulated total dust and dirt begins to level off as portions of the material are picked up by passing traffic, and perhaps by other mechanisms, and displaced onto areas adjacent to the roadways. The displaced material would still be largely available for rapid transport by stormwater runoff in cities because of the high runoff coefficients in these areas. Mechanical fracture to smaller particle size, as well as physical transport, is postulated as the mechanism responsible for leveling off of litter accumulation rates. The ensuing discussion deals with derivation of mathematical expressions to describe deposition and loss rates for roadway materials as well as a general formula describing the relationship between accumulated pollutant loadings and total traffic.

Whereas per axle deposition rates of roadway materials are constant, their removal or loss rates are a function of pollutant loadings. Assuming that the mechanisms for loss of materials deposited on

TABLE 24. COMPARISON OF LOADINGS FROM ROADWAY SAMPLES WITH ONE-DAY AND MULTIPLE-DAY ACCUMULATION PERIODS

Site	Multi-Day Accum. Period (Days)	Ratios of Loadings[a][b] Dry Wt.	Grease	Total Kjeld. N.	Lead	Litter
N. Capitol St. Low-Spd. Lane	3	2.83	2.22	5.00	2.24	1.53
N. Capitol St. Low-Spd. Lane	4	3.57	1.77	0.79	4.40	1.77
N. Capitol St. Low-Spd. Lane	3	2.04	2.54	2.40	2.50	1.83
N. Capitol St. High-Spd. Lane	4	2.03	2.17	1.72	1.94	2.07
CAMP Station	3	1.09	1.32	0.80	0.60	1.44
CAMP Station	3	1.70	1.67	3.00	1.68	1.20
I 495	3	1.90	1.32	1.14	1.96	1.45
I 495	3	2.86	2.08	1.57	2.56	3.41

(a) Ratios given are loadings determined from samples having a three- or four-day accumulation period divided by loadings calculated from samples having a one-day accumulation period. Thus, the expected ratios would be three or four, respectively, if accumulation rates were linear.

(b) Ratios calculated from average loadings for each sampling period have been reported to reduce effects of seasonal variations.

TABLE 24 (CONTINUED). COMPARISON OF LOADINGS FROM ROADWAY SAMPLES WITH ONE-DAY AND MULTIPLE-DAY ACCUMULATION PERIODS

Site	Multi-Day Accum. Period (Days)	Ratios of Loadings[a][b] Dry Wt.	Grease	Total Kjeld. N.	Lead	Litter
I 495	3	1.99	2.13	1.81	1.59	2.70
Loehmann's Plaza	3	1.03	1.01	0.23	1.47	0.56
Loehmann's Plaza	3	2.75	1.76	3.23	4.84	2.21
Balto.-Wash. Parkway	3	1.45	0.86	1.60	0.83	0.75
Kenilworth Ave. Low-Spd. Lane	3	1.44	2.31	0.43	0.69	0.65
Kenilworth Avenue High-Spd. Lane	3	0.91	0.91	0.62	1.01	0.50
Kenilworth Avenue High-Spd. Lane	3	1.55	1.56	1.07	1.06	0.98
Overall Average	3.13	1.86	1.66	1.65	1.88	1.46

(a) Ratios given are loadings determined from samples having a three- or four-day accumulation period divided by loadings calculated from samples having a one-day accumulation period. Thus, the expected ratios would be three or four, respectively, if accumulation rates were linear.

(b) Ratios calculated from average loadings for each sampling period have been reported to reduce effects of seasonal variations.

roadways are mostly traffic related, the following expressions can be derived:

(1) $$\frac{dL_d}{dT} = k_1 \qquad \text{deposition}$$

(2) $$\frac{dL_r}{dT} = k_2 L \qquad \text{removal}$$

(3) $$\frac{dL}{dT} = k_1 - k_2 L \quad \text{net deposition or accumulation rate}$$

Where: L is the roadway pollutant loading in pounds per mile, T is total traffic in axles,

k_1 is the per axle deposition rate as given in Table 14.

k_2 is the fractional removal or loss rate in reciprocal axles.

$$\int_0^L \frac{dL}{k_1 - k_2 L} = \int_0^T dT$$

$$-\frac{1}{k_2} \ln (k_1 - k_2 L) + \frac{1}{k_2} \ln k_1 = T$$

$$\ln \frac{k_1}{k_1 - k_2 L} = k_2 T$$

(4) $$L = \frac{k_1}{k_2} - \frac{k_1}{k_2} e^{-k_2 T}$$

When the rate of removal equals the rate of deposition, the loading will remain constant at its maximum level and

$$\frac{dL}{dT} = 0 \text{ and } L = L_m = \frac{k_1}{k_2}$$

Where: L_m is the maximum pollutant loading, and

(5) $$L = L_m (1 - e^{-k_2 T})$$

The removal rate constant, k_2, is probably a function of traffic speed and, assuming that it is related to the kinetic energy imparted to the particles, is a function of the square of the velocity of the motor vehicle. The constant also contains an interaction factor which is a function of shoulder width or the distance from the curb to the traffic lane.

An approximate value of 1×10^{-5} to 3×10^{-5}/axle was found when total dust and dirt dry weight data from the high- and low-speed lanes of North Capitol Street were used to solve for k_2. The relationships between total dust and dirt dry weight loading and accumulation period shown in Figure 9 were derived using these estimates of k_2, an average daily traffic level of 40,000 axles and a k_1 of 2.38×10^{-3} pounds per axle-mile. The magnitude of the traffic-dependent removal rate constant affects the maximum loading attainable as well as the time required to reach the maximum.

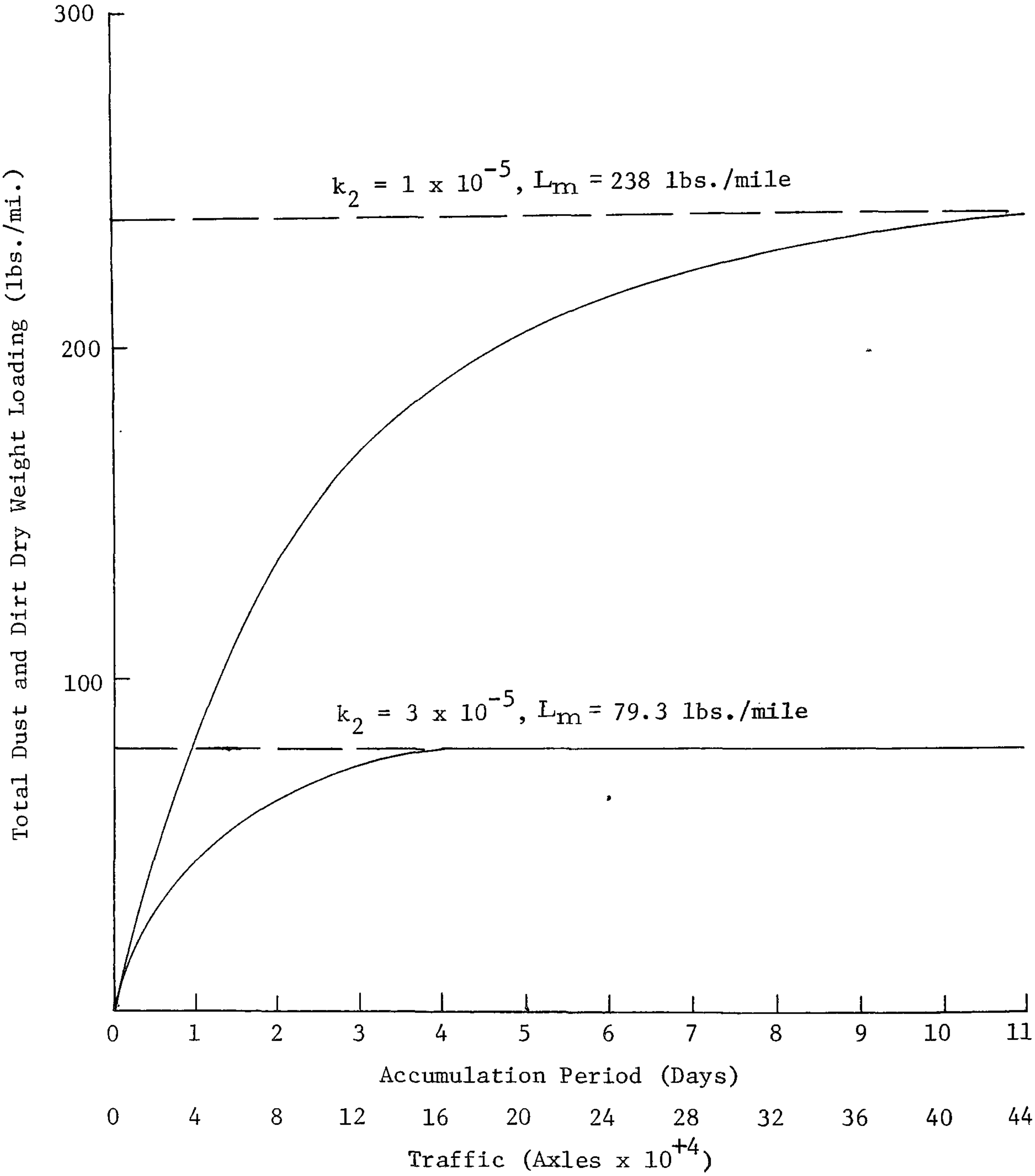
COMPOSITION AND DISTRIBUTION OF PARTICLE SIZES IN ROADWAY DEPOSITS

Particle Size Distribution of Roadway Dust and Dirt Samples

Dust and dirt samples from each of the roadway sites were fractionated into eight mesh sizes in order to determine their particle size distributions. Results of these determinations are given in Table I-1 of Appendix I. The data were then combined and averaged to develop bar graphs shown in Figure 10. Several distinct distribution patterns are evident from the bar graphs. There appears to be no significant differences in the particle size distributions obtained from along the high- and low-speed traffic lanes of Kenilworth Avenue or North Capitol Street. Dust and dirt from the site on an unopened portion of I 95 consisted mostly of smaller particles. This was most probably a result of heavy dusting by the unused concrete roadway surface. Dust and dirt samples from sites at I 495, Loehmann's Plaza, CAMP Station and North Capitol Street had very similar particle size distribution patterns. The fractional amounts steadily increased with decreasing particle size to a maximum at the 75 to 250 micron fraction. The 75 micron and smaller fraction of samples from these sites then dropped off to about the same weight percentage as the 850 to 3,350 micron fraction. Dust and dirt samples from the Kenilworth Avenue site showed a very even distribution among the four largest sieve sizes and contained only about 5% by weight of particulates 75 microns in diameter and smaller. Samples from the Baltimore-Washington particle showed a rather even distribution over all particle size ranges.

Composition of Dust and Dirt Sieve Fractions

A total of 12 roadway dust and dirt samples were divided into five sieve fractions for chemical analysis as a function of particle size. These results are shown in Table I-2 of Appendix I and summarized as averages in Table 25. Concentrations or strengths of the different pollutional parameters showed several patterns of variation with particle size; however, the smallest sized particles were almost invariably most highly



($k_1 = 2.38 \times 10^{-3}$ lbs./axle-mile, ADT = 40,000 axles)

Figure 9. Total dust and dirt dry weight accumulation

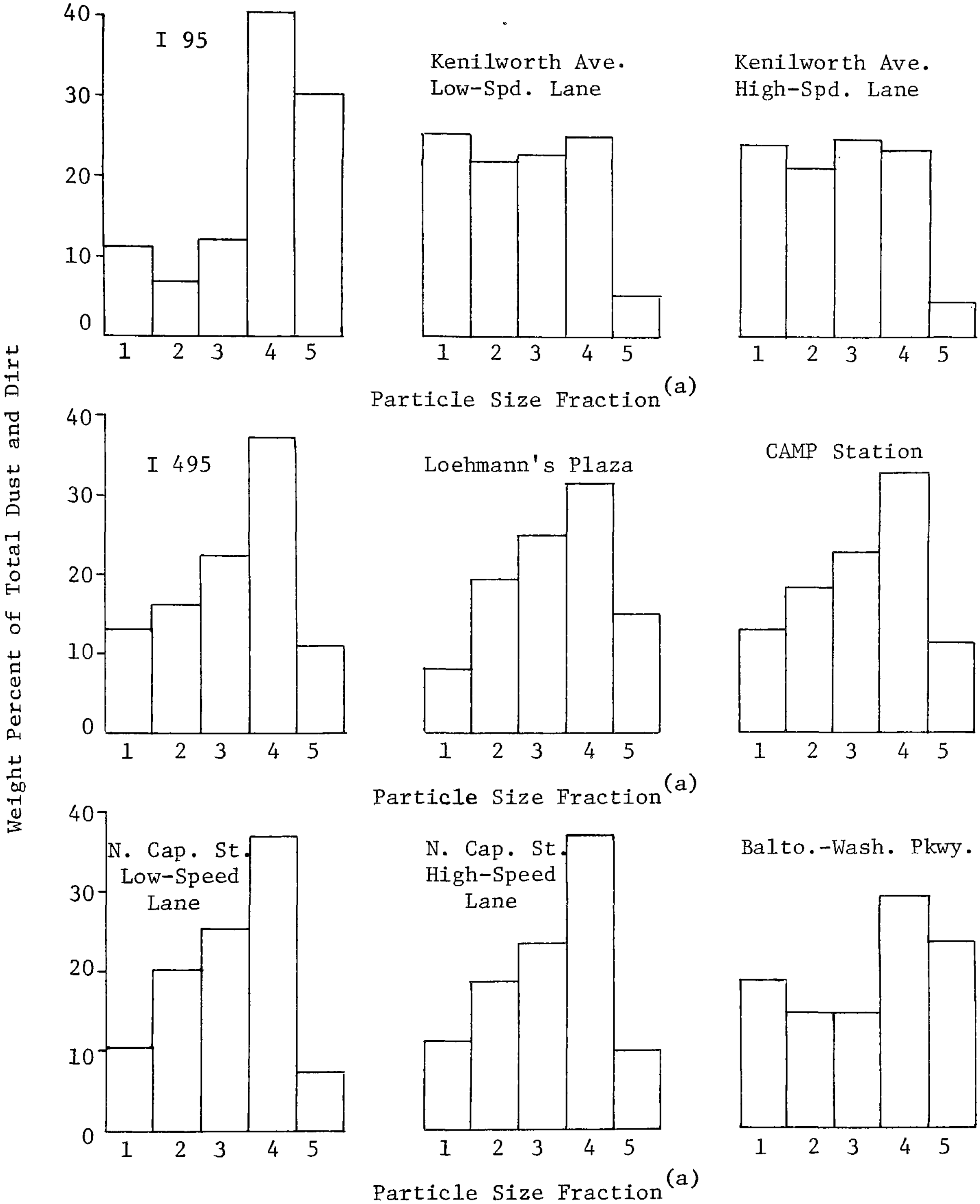


Figure 10. Average particle size distributions roadway dust and dirt samples

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(a) Particle size fraction 1 is 3350 to 850 microns, 2 is 850 to 420 microns, 3 is 420 to 250 microns, 4 is 250 to 75 microns and 5 is 75 microns and smaller.

contaminated. Volatile solids, BOD, COD and grease concentrations were highest in the 75 micron and smaller fraction, at a minimum in the intermediate size ranges and generally somewhat higher in the 850 to 3350 micron dust and dirt fraction. Concentrations of asbestos fibers were generally higher in the small sized fractions, but rather surprisingly, were more evenly distributed over the range of particle sizes than most of the other pollutants. This indicated that the fibers were bound to particle surfaces since all asbestos fibers would readily pass through the smallest sieve used here. Rubber concentrations were uniform or increased slightly with decreasing particle size until the 75 micron and smaller fraction where they usually increased markedly. Concentrations of the metals generally increased with decreasing particle size. However, this increase was not as dramatic as with other parameters.

TABLE 25. AVERAGE CONCENTRATION OF POLLUTANTS IN ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE

Particle Size (microns)	Dry Weight (%)	Volatile Solids (mg/g)	BOD (mg/g)	COD (mg/g)	Grease (mg/g)
3350-850	15.0	76.1	3.64	67.5	9.0
850-420	19.3	43.2	2.98	55.7	6.4
420-250	23.6	34.2	3.11	51.2	6.4
250- 75	31.9	59.3	3.80	106.4	14.5
75-	10.2	125.6	6.91	211.2	29.8

Particle Size (microns)	Asbestos (10^{+5} x fbrs./g)	Rubber (mg/g)	Lead (mg/g)	Zinc (mg/g)
3350-850	0.7	0.7	0.81	0.24
850-420	1.5	1.0	3.20	1.02
420-250	1.6	1.5	3.44	1.60
250- 75	2.3	4.5	5.89	1.81
75	1.2	17.8	6.43	1.56

More important than variations in strength with particle size are the fractional distributions of the total amount of a pollutant. This latter distribution gives a measure of the relative significance of each particle size fraction, assuming that the sieve fractions are transported to receiving waters with similar efficiencies. Studies by URS Research Company have shown that this is largely true for dust and dirt (11). Fractions of total pollutant associated with each dust and dirt particle size range are given in Table 26 for samples taken at each roadway site. Data given in the table have been averaged and represent composite samples. Results on samples from high- and low-speed lanes at Kenilworth Avenue have been combined as have those taken at North Capitol Street. Substantial amounts of each pollutant are

TABLE 26. TOTAL POLLUTANT ASSOCIATED WITH EACH DUST AND DIRT SIZE RANGE

Roadway Site	Size Range[(a)]	Percent of Total									
		Vol. Sol.	BOD	COD	Grease	Petrol.	n-Par.	Tot. PO_4-P	NO_3-N	NO_2-N	TKN
Kenilworth Ave.	1	35.0	21.2	16.4	21.7	22.8	22.1	22.7	16.3	34.3	29.2
	2	14.7	24.9	16.2	16.1	15.8	16.9	18.2	20.2	26.7	21.7
	3	18.6	17.2	16.7	23.3	19.3	16.0	19.6	24.5	11.1	13.4
	4	21.0	24.3	36.2	26.4	27.2	29.1	31.3	29.4	22.2	24.1
	5	10.7	12.4	14.5	12.5	14.9	15.9	8.2	9.6	5.7	11.6
I 495	1	9.2	8.2	8.2	8.8	10.0	7.4	6.3	3.9	8.3	17.4
	2	9.9	12.5	9.6	7.2	8.6	8.9	12.3	5.9	12.5	13.7
	3	14.6	18.1	14.1	14.7	15.8	13.7	15.7	15.7	19.6	14.0
	4	46.0	43.0	46.4	46.2	44.1	46.7	43.7	43.7	34.4	35.8
	5	20.3	18.2	21.7	23.2	21.5	23.3	30.8	30.8	25.2	19.1
Loehmann's Plaza	1	9.4	11.3	6.4	5.4	5.7	6.2	4.2	14.4	5.3	8.6
	2	17.3	16.7	13.7	10.8	9.5	8.3	12.5	13.5	13.9	29.6
	3	10.4	21.0	13.1	9.3	10.1	8.5	22.4	12.2	17.6	17.6
	4	29.9	26.0	33.8	37.6	29.3	32.9	28.7	32.0	17.3	25.8
	5	33.0	25.0	33.0	36.9	45.4	44.1	32.2	27.9	45.9	18.4
CAMP Station	1	25.1	20.8	21.2	17.0	13.4	12.2	11.9	17.1	52.8	31.5
	2	17.0	19.0	16.0	8.7	6.6	7.6	14.5	14.1	11.2	28.8
	3	17.1	24.5	18.2	15.3	15.0	16.3	18.3	18.7	0.0	18.5
	4	34.0	28.6	37.0	49.8	54.1	52.5	47.5	40.9	16.9	18.9
	5	6.8	7.1	7.6	9.2	10.9	11.4	7.8	9.2	19.1	2.4
N. Capitol Street	1	12.5	6.5	6.1	5.3	4.9	5.1	8.7	5.9	5.6	4.8
	2	9.2	9.7	8.0	5.8	6.2	6.4	12.2	12.8	9.9	20.2
	3	11.0	17.1	11.7	6.7	9.8	10.1	15.3	14.9	0.0	22.7
	4	42.7	42.4	44.7	49.4	49.1	48.4	45.2	45.7	35.2	34.5
	5	24.6	24.3	29.5	32.8	30.0	30.0	18.6	20.7	49.3	17.8
Balto.-Wash. Pkwy.	1	16.1	11.5	12.2	11.5	7.9	8.3	9.6	11.2	13.0	29.2
	2	8.8	10.9	8.8	13.2	7.9	5.9	10.7	9.8	14.1	22.5
	3	5.6	7.7	8.2	5.6	5.2	5.1	10.5	9.2	16.1	16.0
	4	30.2	25.1	31.1	31.5	35.8	34.5	40.3	22.9	32.8	13.1
	5	39.3	44.8	39.7	38.2	43.2	46.3	28.9	46.9	24.0	19.2

(a) Particle size range 1 is 3,350 to 850 microns, 2 is 850 to 420 microns, 3 is 420 to 240 microns, 4 is 250 to 75 microns and 5 is 75 microns and smaller.

TABLE 26 (CONTINUED). TOTAL POLLUTANT ASSOCIATED WITH EACH DUST AND DIRT SIZE RANGE

Roadway Site	Size Range[(a)]	Percent of Total								
		Cl	Fec. Strep.	Asbestos	Rubber	Pb	Cr	Ni	Zn	Cu
Kenilworth Ave.	1	17.5	-	11.5	6.0	3.7	20.5	32.7	4.5	10.5
	2	16.1	-	27.1	10.9	23.2	18.7	13.6	18.5	19.2
	3	30.0	-	13.1	17.5	19.0	20.8	13.8	25.2	24.1
	4	26.9	-	45.7	38.1	48.3	34.0	33.2	43.3	36.4
	5	9.5	-	2.6	27.5	5.8	6.0	6.7	8.5	9.8
I 495	1	10.9	-	1.3	1.6	1.7	6.6	14.4	0.9	4.0
	2	16.6	-	22.0	5.3	8.9	10.0	16.5	5.4	19.3
	3	20.8	-	19.4	8.3	21.7	23.4	15.5	20.8	20.5
	4	36.6	-	55.5	57.6	46.8	40.0	32.8	57.1	32.8
	5	15.1	-	1.8	27.2	20.9	20.0	20.8	15.8	23.4
Loehmann's Plaza	1	9.5	-	0.4	0.6	1.0	2.8	3.3	0.4	3.2
	2	22.7	-	4.7	2.3	6.1	15.2	10.7	12.5	4.1
	3	18.5	-	27.7	2.8	14.2	18.5	20.9	27.9	16.2
	4	24.2	-	45.0	23.7	57.6	34.4	42.0	42.1	47.6
	5	25.1	-	22.2	70.6	21.1	29.1	23.0	17.1	28.9
CAMP Station	1	26.2	-	4.1	4.1	19.7	43.7	67.0	29.6	17.8
	2	17.1	-	23.1	4.3	49.6	14.7	10.3	22.6	13.6
	3	6.1	-	38.6	17.9	9.9	13.8	8.5	19.1	8.7
	4	35.2	-	34.2	39.0	15.8	22.8	12.1	22.6	47.5
	5	15.4	-	0.0	34.7	5.1	5.0	2.1	6.1	12.3
N. Capitol Street	1	5.0	5.4	52.4	3.7	1.9	13.0	16.0	0.4	7.7
	2	9.0	1.2	10.0	5.9	9.1	7.8	12.4	12.2	8.4
	3	14.7	2.6	9.7	10.3	10.9	10.5	19.4	35.0	8.6
	4	45.5	63.6	27.9	44.5	34.9	46.1	30.8	41.9	47.7
	5	25.8	27.2	0.0	35.6	43.2	22.6	21.4	10.5	27.6
Balto.-Wash. Pkwy.	1	12.0	-	8.4	2.0	11.0	14.4	21.7	7.6	5.3
	2	6.7	-	6.3	3.9	13.0	12.5	7.3	11.8	5.7
	3	9.6	-	14.2	11.0	17.1	12.5	18.8	21.5	4.3
	4	33.1	-	29.2	23.7	53.7	43.6	25.8	35.6	53.4
	5	38.6	-	41.9	59.4	5.2	17.0	26.4	23.5	31.3

(a) Particle size range 1 is 3,350 to 850 microns, 2 is 850 to 420 microns, 3 is 420 to 240 microns, 4 is 250 to 75 microns and 5 is 75 microns and smaller.

associated with the two smaller particle size ranges. This factor is of considerable importance as regards public works practices since sweeper efficiencies fall off with decreasing particle size.

Contributions from Litter

Prior to this study, the fractional amounts of roadway surface pollutants contained in particulates larger than 3,350 microns was thought to be of lesser importance. However, the data given in Table 27 clearly shows that litter averages over 20% of the total weight of material gathered from roadways and contains even more substantial fractional amounts of BOD, COD and volatile solids. Fortunately, the impact upon receiving waters of this disproportionate loading in litter is greatly reduced by its large particle size which greatly retards in transport by stormwater runoff. Litter is removed at high efficiencies by conventional street cleaning equipment. It is doubtful, therefore, that litter compares in magnitude with dust and dirt as a source of pollution of receiving waters in metropolitan areas.

TABLE 27. FRACTIONAL AMOUNTS OF TOTAL POLLUTANTS ASSOCIATED WITH LITTER

Site	Percent (by Weight) in Litter[(a)]			
	Dry Wt.	Volatile Solids	BOD	COD
Kenilworth Ave. Low-Spd. Lane	34.0	54.7	30.7	39.7
Kenilworth Ave. High-Spd. Lane	27.2	47.0	27.6	39.5
I 495	9.0	26.6	24.4	23.5
Loehmann's Plaza	9.7	40.6	18.9	23.9
CAMP Station	26.8	59.7	56.7	57.0
N. Capitol St. Low-Spd. Lane	20.2	55.5	41.9	47.2
N. Capitol St. High-Spd. Lane	9.2	39.1	15.8	18.3
Balto.-Wash. Pkwy.	40.5	28.0	64.8	72.1
I 95	2.5	0.8	1.2	2.0
Overall Average	21.5	43.3	34.6	39.9

(a) The data reported are average percent pollutant by weight in litter of the total found in litter and dust and dirt.

REDISTRIBUTION OF MATERIALS DEPOSITED ON ROADWAYS

The procedure for collection of roadway samples, as described in Appendix E requires preliminary brushing of from 10 to 15 feet of the street on either side of the roadway sampling site prior to sample collection. The question was raised during the field study as to whether roadway samples thus collected might contain significant amounts of materials redistributed from uncleaned, adjacent areas as a result of winds or localized air currents. This redistribution would tend to obscure determination of the fresh deposition of pollutants due to traffic over the specified sampling interval.

TABLE 28. REDISTRIBUTION OF MATERIALS DEPOSITED ON ROADWAY - BLOW-IN EXPERIMENT (a)

Kenilworth Avenue - Low-Speed Lane

Road Section	First 24-Hour Sample: Litter (g)	First 24-Hour Sample: Dust & Dirt (g)	First 24-Hour Sample: Grease (mg/g)	Second 24-Hour Sample: Litter (g)	Second 24-Hour Sample: Dust & Dirt (g)	Second 24-Hour Sample: Grease (mg/g)
1	47.8	125.2	10.8	54.6	95.0	8.8
2	38.6	113.2	10.9	-	-	-
3	84.2	226.5	8.2	-	-	-
4	37.4	137.2	12.7	70.1	167.9	11.8
5	49.4	114.9	11.7	34.1	89.0	11.5
6	46.5	154.1	9.0	40.4	104.4	9.6

I-495 - High-Speed Lane

Road Section	First 24-Hour Sample: Litter (g)	First 24-Hour Sample: Dust & Dirt (g)	First 24-Hour Sample: Grease (mg/g)	Second 24-Hour Sample: Litter (g)	Second 24-Hour Sample: Dust & Dirt (g)	Second 24-Hour Sample: Grease (mg/g)	Weekend Sample: Litter (g)	Weekend Sample: Dust & Dirt (g)	Weekend Sample: Grease (mg/g)
1	251	2915	7.2	169	1933	4.5	435	4357	5.0
2	179	1556	6.7	131	2098	5.6	525	5351	5.8
3	108	1160	7.8	170	1763	7.3	335	5290	6.5

In order to determine whether significant amounts of blow-in were occurring, special experiments were conducted at two of the selected roadway sites. Multiple, adjacent roadway sections of equal curb length were subjected to an initial cleaning followed by acquisition

(a) Data reported are weights and analyses of roadway deposits taken from adjacent sections of roadway after the stated accumulation period.

of separate samples from each adjacent section on the following day. If blow-in was a significant factor, lower loadings might be expected on the interior sections or perhaps a trend of decreased loadings in the direction of traffic or the prevailing winds.

The first experiment was conducted on the southbound lane of Kenilworth Avenue south of Eastern Avenue in a 45-mile-per-hour zone. Six adjacent 60-foot sections of the low-speed (right) lane were sampled on two successive days, 24 hours after an initial cleaning and again 24 hours later. The samples were returned to the laboratory where they were sieved, weighed, and analyzed. A similar experiment was performed on the eastbound lane of Interstate Route 495 near the New Hampshire Avenue exit. The speed limit at this site is 65 miles per hour. Three adjacent 80-foot sections of the high-speed (left) lane were sampled 24 hours after an initial cleaning and again 24 hours later. A third sampling was conducted, after a weekend, 72 hours after the previous cleaning. The results of this study are shown in Table I-3 of Appendix I. These data have been condensed for presentation in Table 28. Examination of the results reveals no trends in the loadings. This indicates that redistribution or blow-in does not represent a significant portion of the roadway samples as acquired.

SECTION VII

STREAM BOTTOM AND STORMWATER RUNOFF SAMPLING

There are several ways in which stormwater runoff from urban roadways can affect receiving bodies of water. First, dramatic effects may result during stormwater runoff periods in which shock loadings of particulates, toxic materials, nutrients and oxygen demanding substances are abruptly introduced. Since such events will occur several times over the course of a year in most areas, permanent changes may be introduced in the biological species existing in the affected downstream length of the receiving stream. There may also exist on a more or less permanent basis, a dry weather sphere of influence near the roadway/receiving water interface. Particulates introduced into the water during storm events will settle out at various distances downstream from the outfall. The roadway pollutants associated with these particulates may then exert a constant effect upon the stream biology a as they provide a constant sink of slowly dissolving toxic materials such as heavy metals, PCB's and grease. A series of stream bottom samplings was conducted in order to determine if such a dry weather sphere of influence of the roadway on the receiving water could be detected above the background of impurities added from other sources within an urban area. Several storm events were monitored in which runoff from along I 495 was measured.

STREAM BOTTOM SAMPLING

Prior to actual stream bottom sampling, a special study was conducted on dry land beneath a longitudinal joint in the roadway of an I 495 overpass near Sligo Creek in suburban Maryland. The longitudinal joint was two to three inches wide, near the center of and parallel to the roadway which runs generally east-west at this point. A channel had been formed on the dry land beneath the joint by intermittent runoff from the roadway. The land underneath the overpass was even, uniform in appearance, and fairly flat with only a slight slope running downhill from west to east. The area has been graded and is the roadbed for the proposed Northern Parkway. Samples of soil were taken during a dry period at varying distances north and south of the channel in order to look for transport of heavy metals perpendicular to flow of the intermittent stream. Results of this study are shown in Figure 11. Peak concentrations of lead resulting from the roadway runoff are clearly visible.

Having demonstrated the feasibility of this approach, an actual sampling was conducted at the runoff outfall from I 495 into the Northwest Branch of the Anacostia River. A diagram of the area with sampling points indicated is given in Figure 12. The stream is rapidly flowing and pooled along this sampling area and the bottom samples appeared to be predominantly sand mixed with some silt. PCB's and chlorinated pesticides were measured in addition to heavy metals in these bottom samples.

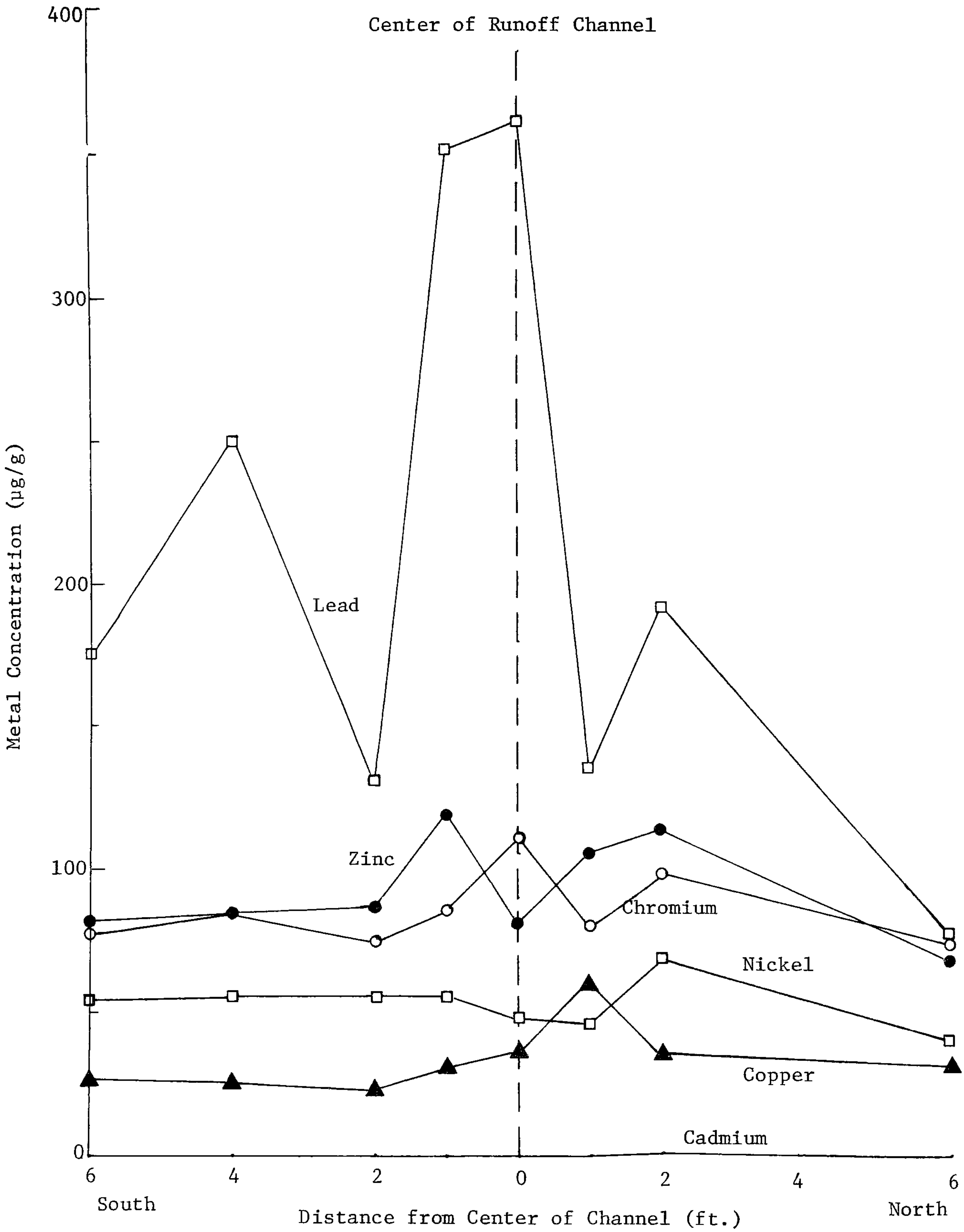


Figure 11. Heavy metals across runoff channel under I 495
(Bridge No. 15131)

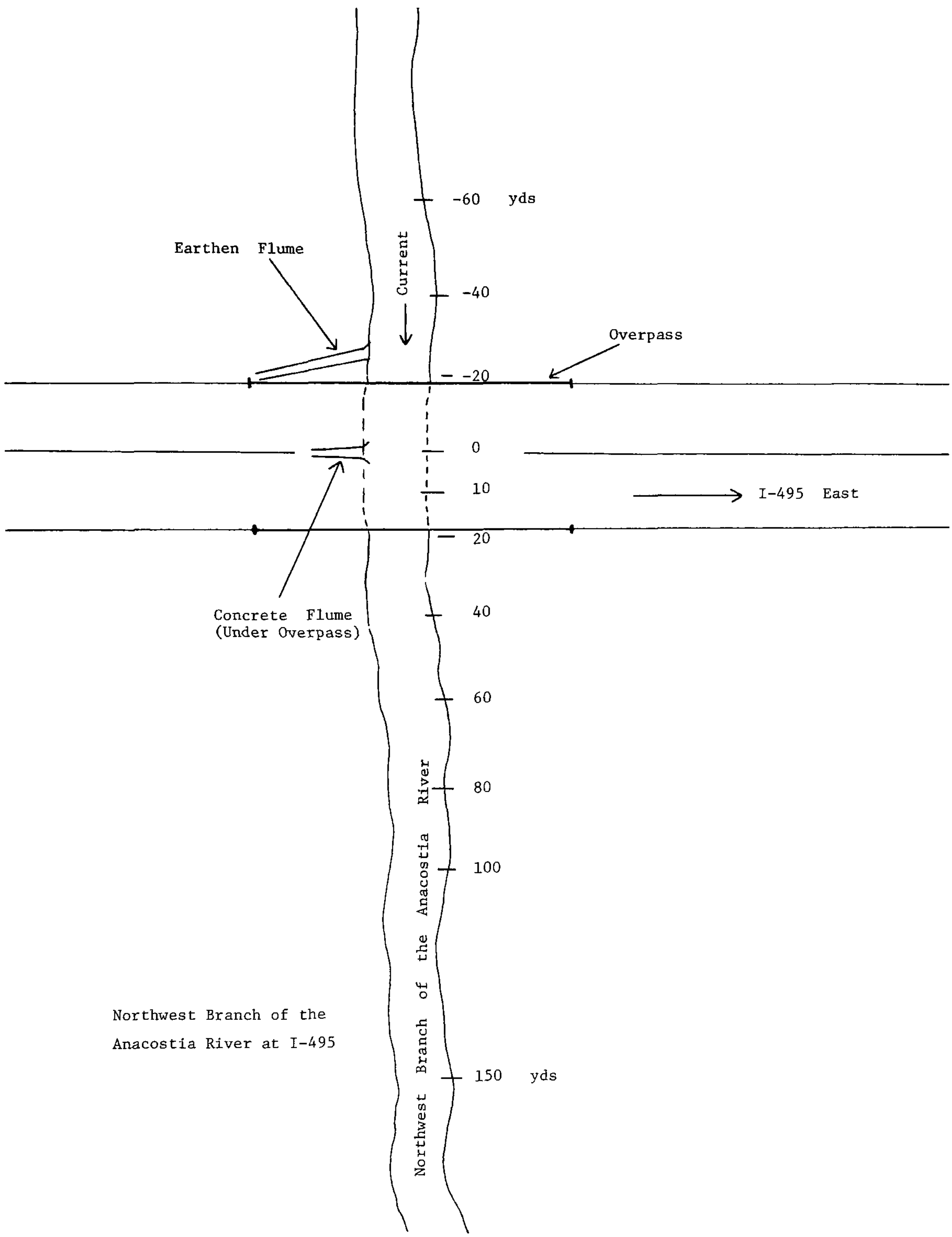


Figure 12. Northwest Branch of Anacostia River at I 495 - stream bottom sampling area

Heavy metals and chlorinated organics levels found in bottom samples taken from the Northwest Branch of the Anacostia River at I 495 are shown in Figure 13 as a function of distance from the runoff flume beneath the center of the roadway. Downstream distances are shown as positive numbers, upstream as negative numbers. Note the earthen runoff flume indicated in Figure 12, which is approximately 25 yards upstream from the center of the overpass. This is the first apparent point of entry of roadway runoff into the Northwest Branch. The heavy metal concentrations were at a maximum in the immediate area of the roadway while the PCB's peak occurred about 60 yards downstream from the roadway. The downstream translocation of the PCB's peak is probably due to the greater association of organic compounds with smaller sized particulates which would require a longer time for settling. No pesticides were found in any bottom samples collected at this site. This was as expected since pesticides were not detected at significant concentrations in any of the roadway dust and dirt samples analyzed. Heavy metal levels in roadway dust and dirt samples generally occurred in the order lead > zinc > nickel > copper = chromium with very low levels of cadmium present. As expected, stream bottom samples from the Northwest Branch contained little or no cadmium; however, concentrations of other metals were not in the anticipated order. The lead maximum was much smaller than would be predicted based upon relative amounts found in roadway deposited materials. The zinc maximum, although larger than lead, was smaller than expected in relationship to chromium, nickel and copper, again based upon the relative amounts found in roadway dust and dirt.

Similar stream bottom studies were conducted on Sligo Creek in Maryland at an outfall from I 495 and on an unnamed tributary of the Anacostia River crossing the Baltimore-Washington Parkway in Greenbelt Park in Maryland. However, the effects of these roadways upon the stream bottoms was not clearly defined in these cases, probably due to heavy metals introduced into the streams from industrial sources.

Despite inability to clearly "see" the roadway in some cases, feasibility of determining the dry weather area of influence of a roadway along the length of the receiving stream has been demonstrated. This approach should be more widely applicable to the study of roadways outside of industrialized urban areas.

STORMWATER RUNOFF SAMPLING

Six storm events were monitored at outfalls carrying runoff from I 495 into the Northwest Branch of the Anacostia River. The outfalls sampled were located on either side of and beneath the Northwest Branch overpass approximately 300 to 400 yards west of the roadway sampling site on I 495. Five runoff events were monitored at the outfall on the western side of the overpass and one event was monitored at the eastern outfall. The roadway areas drained by the two outfalls were approximately 15,000 and 600 square feet, respectively. A diagram showing the drainage areas is given in Figure 14. It is believed that runoff from these drainage

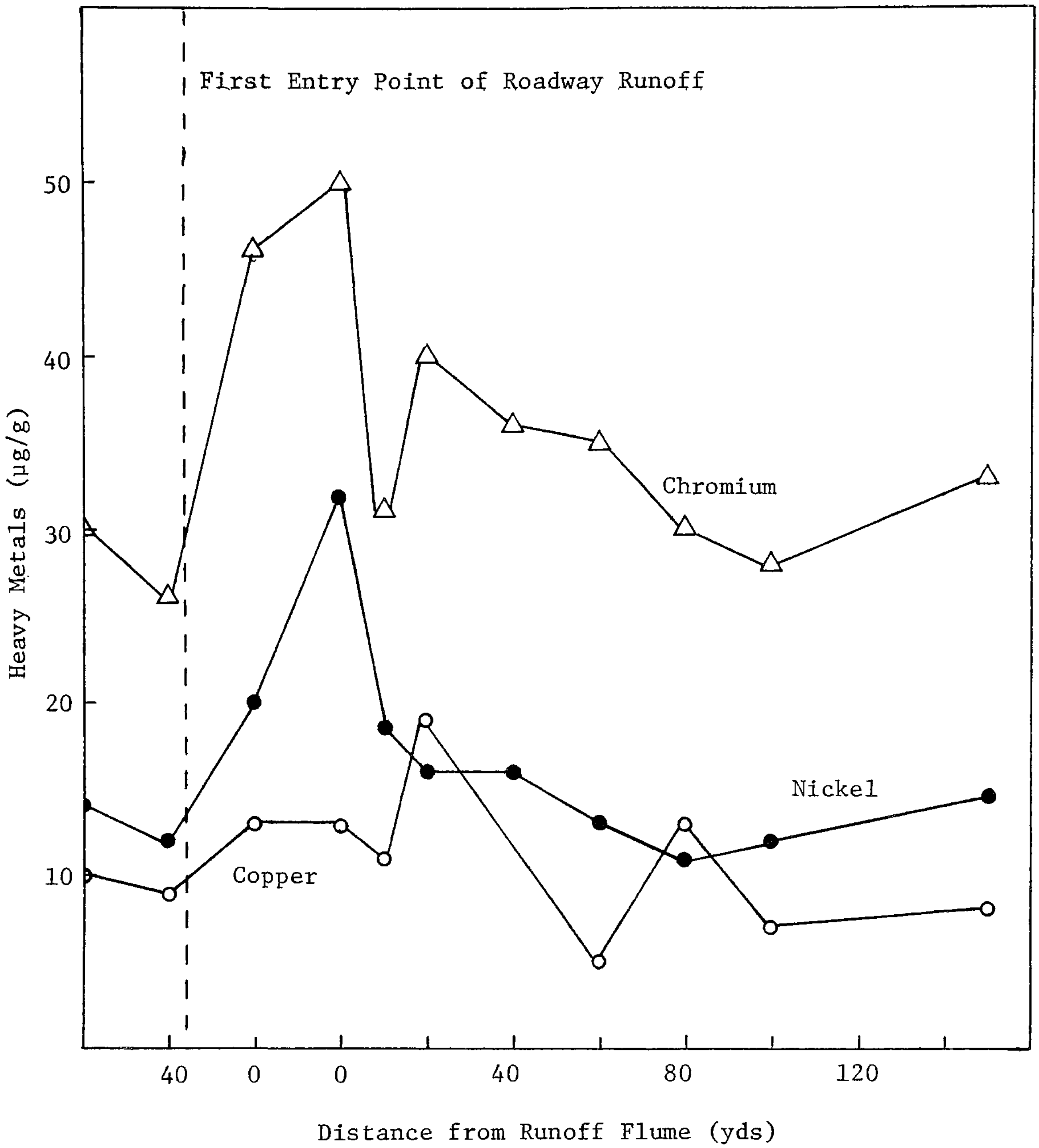


Figure 13. Heavy metals in stream bottom samples - Northwest Branch of Anacostia River at I-495

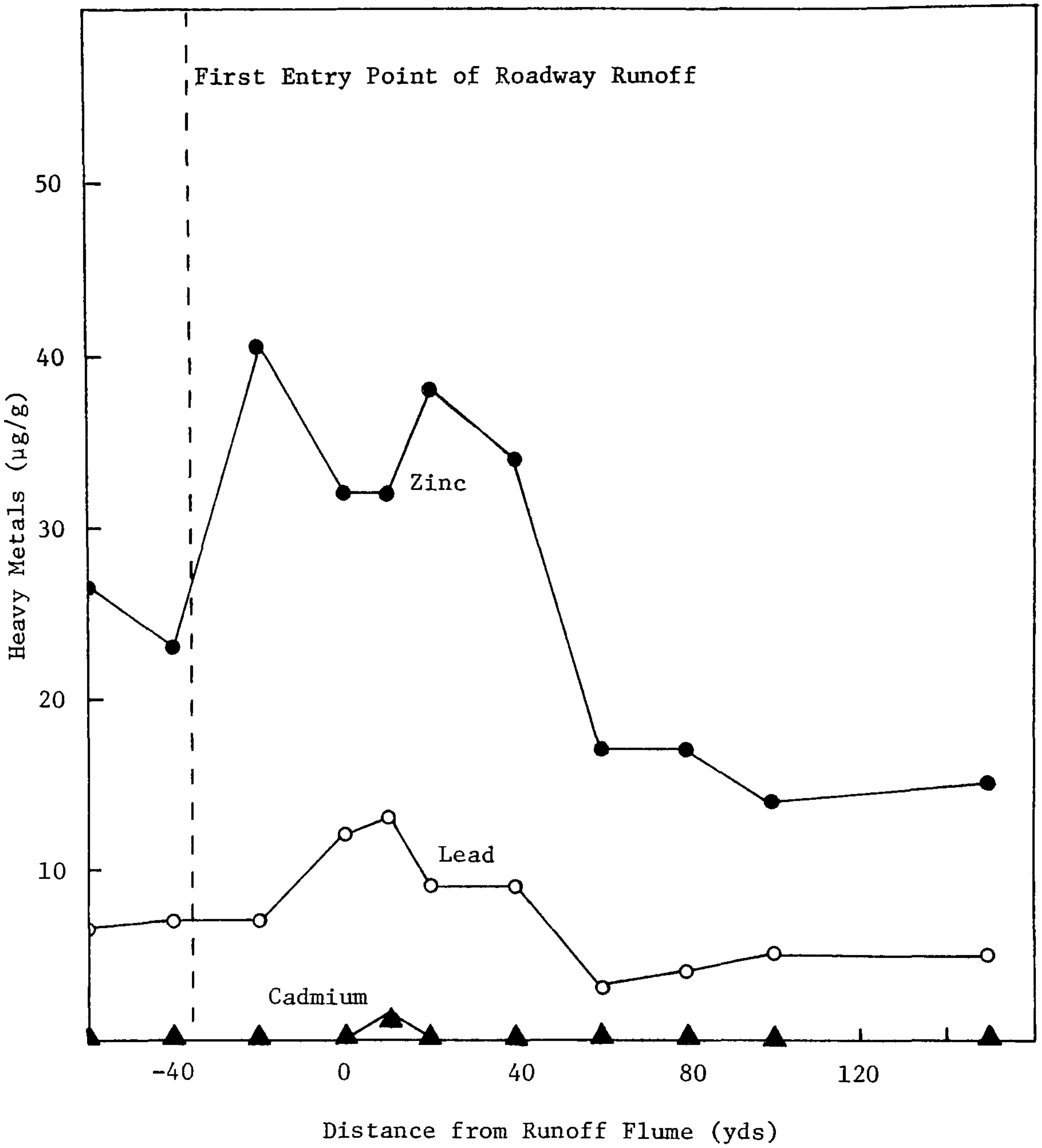


Figure 13 (continued)

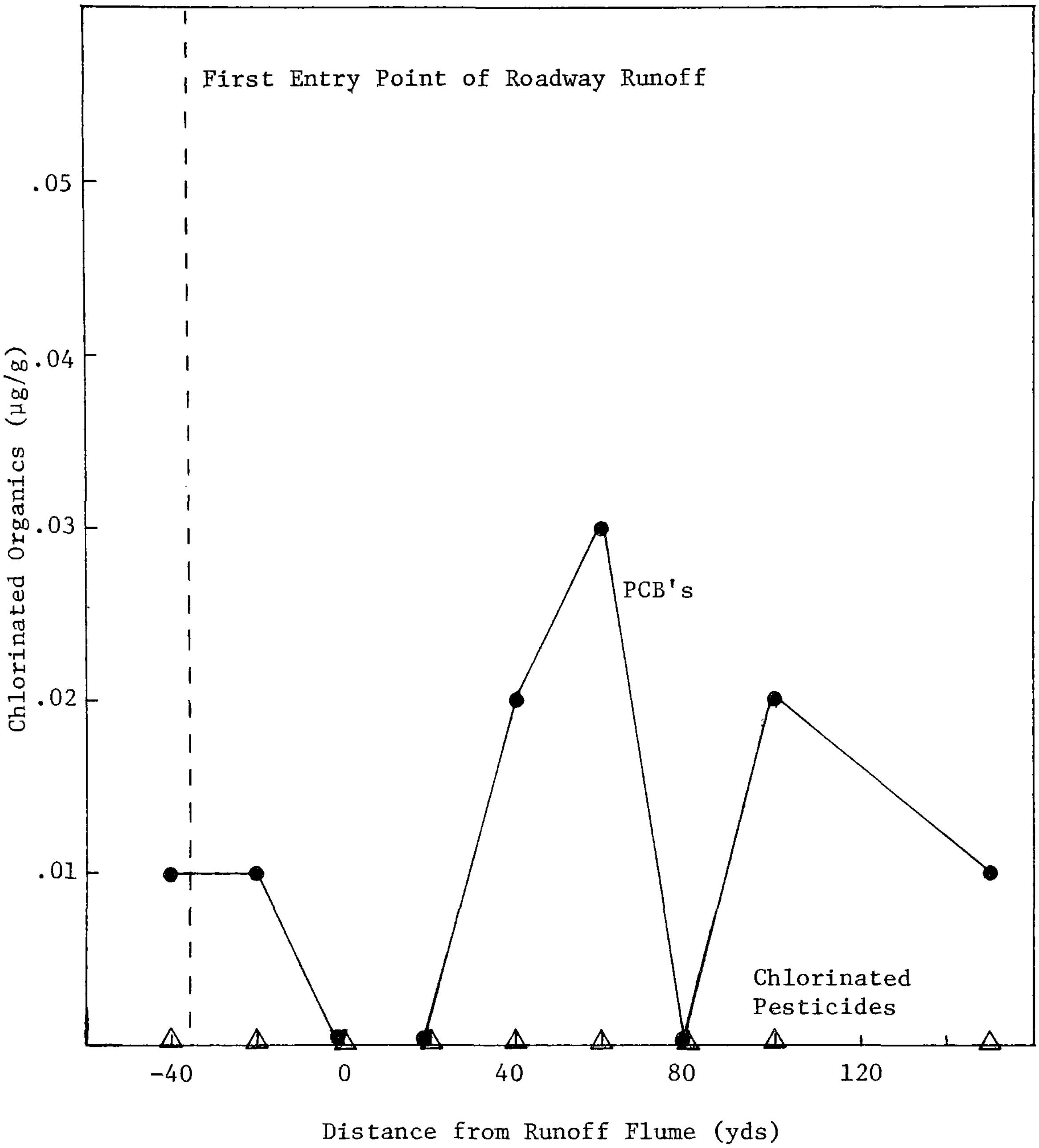
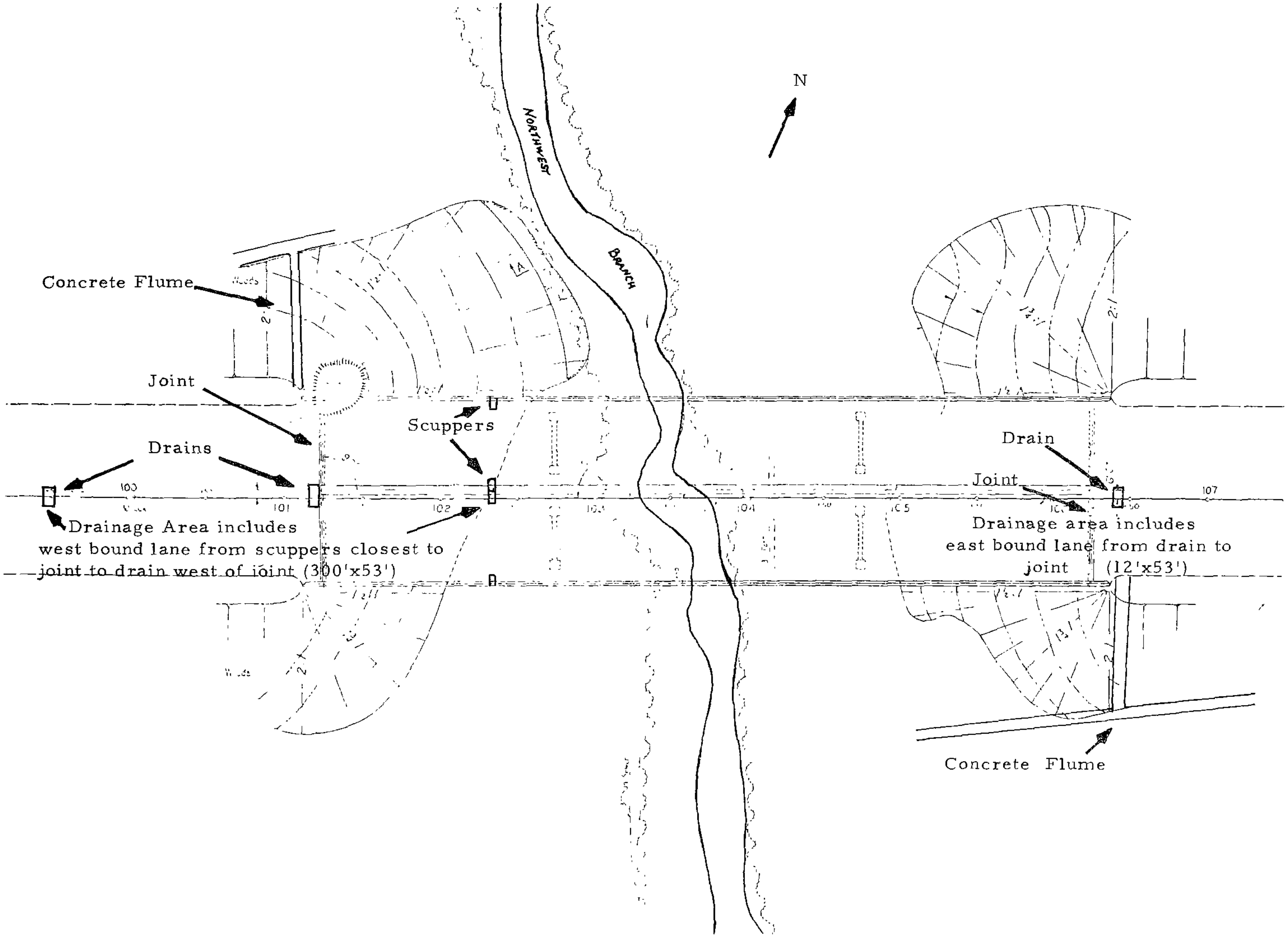


Figure 13 (continued)

Figure 14. I 495 drainage areas for storm event monitoring

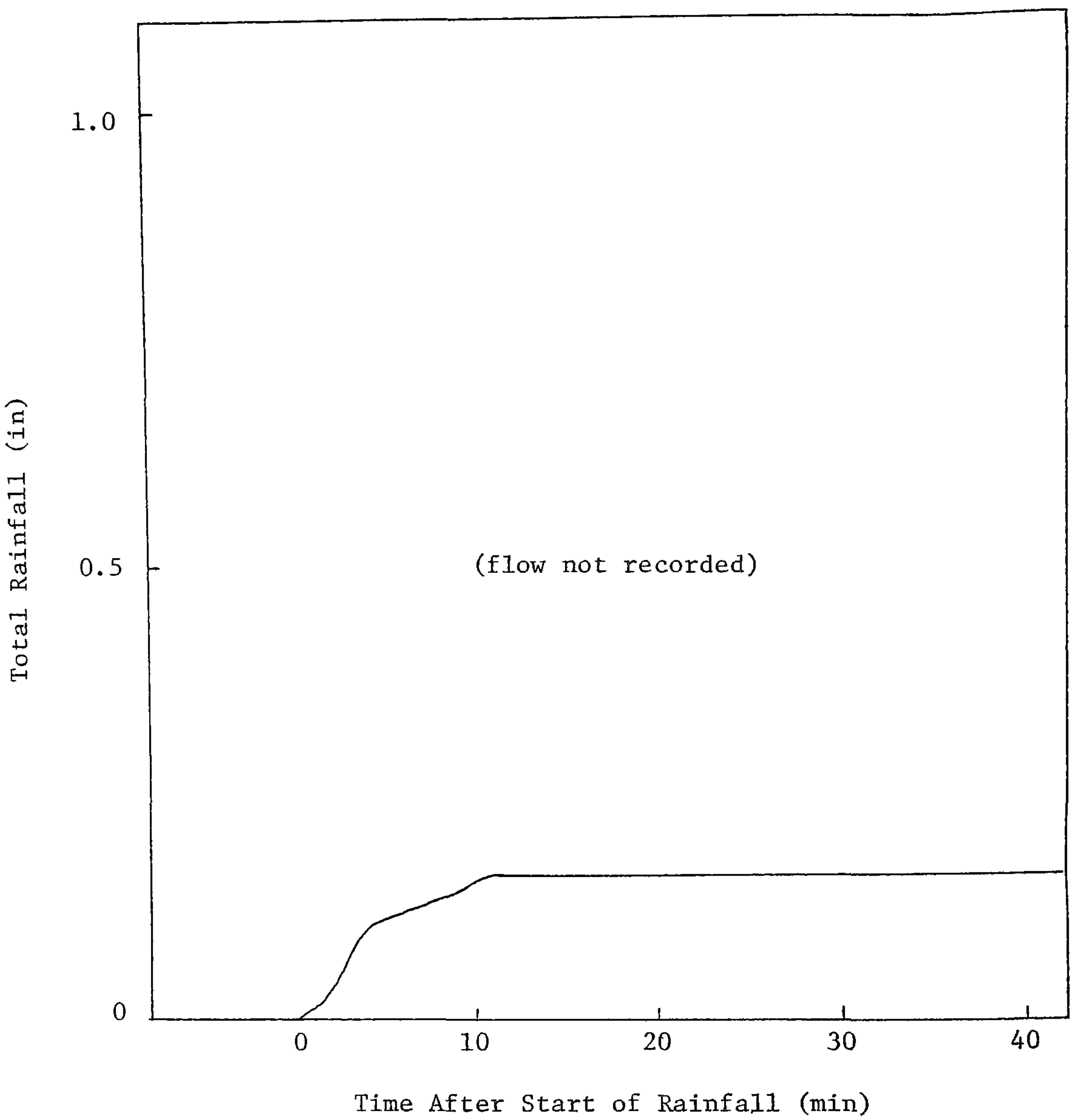


areas contained mostly materials previously deposited on the roadway. Carry over onto the roadway of materials eroded from adjacent higher areas was prevented by slope of the roadway and surface drainage ditches running parallel to I 495.

Storm events were monitored by measuring total rainfall, runoff flow rate and concentration of pollutants in runoff samples taken at known intervals throughout the storm. Data from the storm event of 31 July 1973 are shown in Figure 15. The flowmeter malfunctioned during this storm and no flow measurements were obtained. Figures 16 through 19 describe storm events on 21 August 1972, 2 September 1973, 14 September 1973 and 18 September 1973, respectively. The storm event of 6 September 1974, shown in Figure 20, was monitored at the outfall on the eastern side of the I 495 overpass. Runoff yields averaged about 75% of that predicted from rainfall over the estimated drainage areas.

Inspection of these data reveals a marked first flush effect in which the concentrations of runoff pollutants are initially high and then fall off to a lower, but still significant level which would require treatment. The first flush was less noticeable during storms with a low, even rate of runoff. Runoff samples taken at these outfalls were still highly polluted after three hours of continuous flow. Concentrations tended to increase again, after the initial flush of the roadway surface, when there was an increase in the runoff flow rate. The second concentration peaks may be quite high, depending upon flow kinetics and amounts of materials already washed off the roadway.

It was observed that soluble zinc levels were almost always higher than soluble lead in roadway runoff, this despite the fact that materials deposited on roadways contained approximately eight times more lead than zinc. This indicates that the deposited zinc compounds are more soluble than the lead compounds. Additionally, the ratio of total lead to zinc in runoff samples was much lower than expected which suggests that zinc is washed from the roadways at a faster rate. This is graphically illustrated in Figure 18 which contains a sharp second peak in suspended solids levels resulting from an increased rate of rainfall and/or runoff flow during the storm event. The total lead concentrations at this second peak in suspended solids level rises sharply while total zinc continues to decrease. This would indicate that much of the deposited zinc had already been removed, probably in solution, prior to the second flush of roadway solids.



(Outfall on Western End of I 495 Overpass at Northwest Branch)

Figure 15. Storm event of 31 July 1973

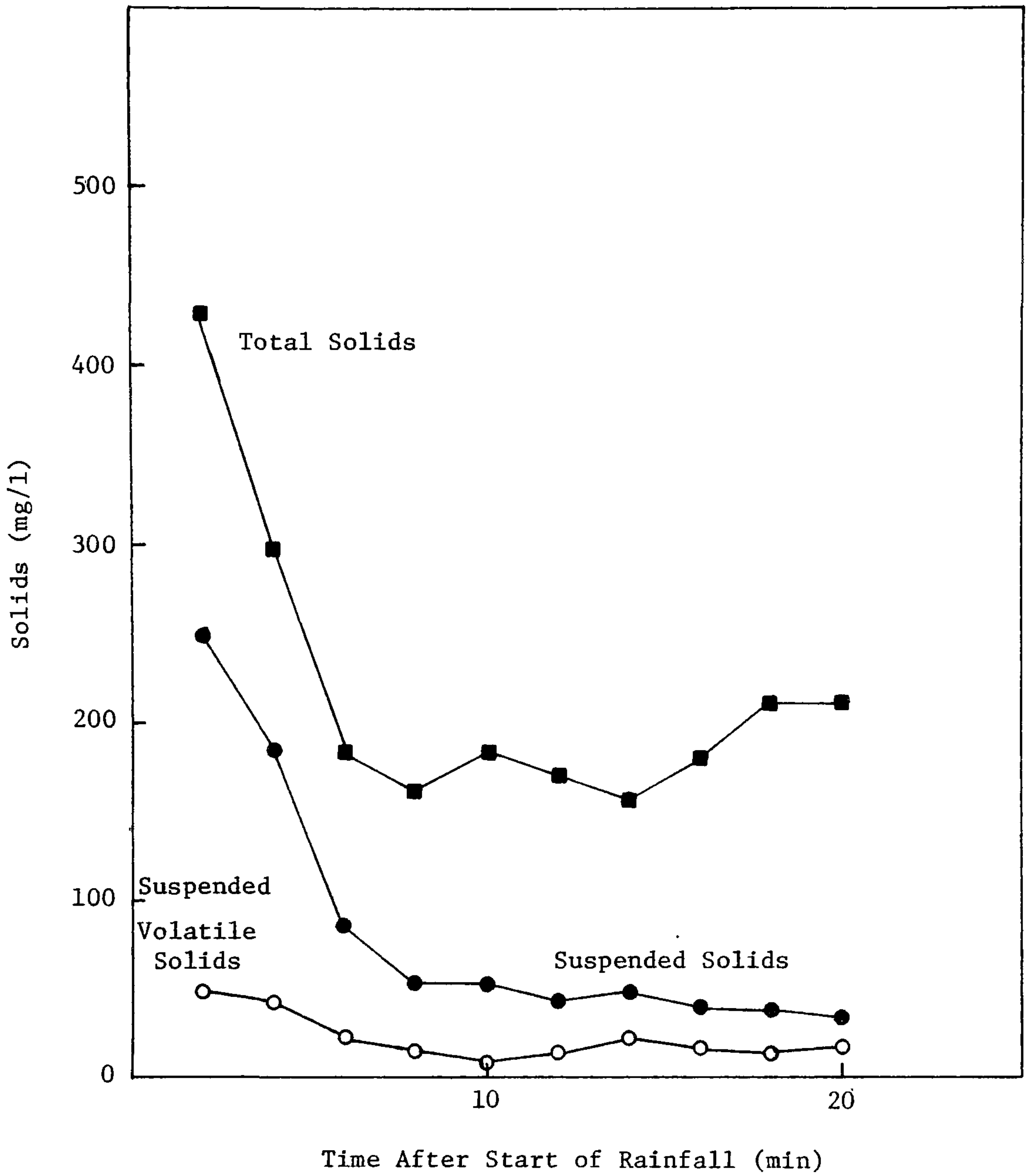


Figure 15 (continued)

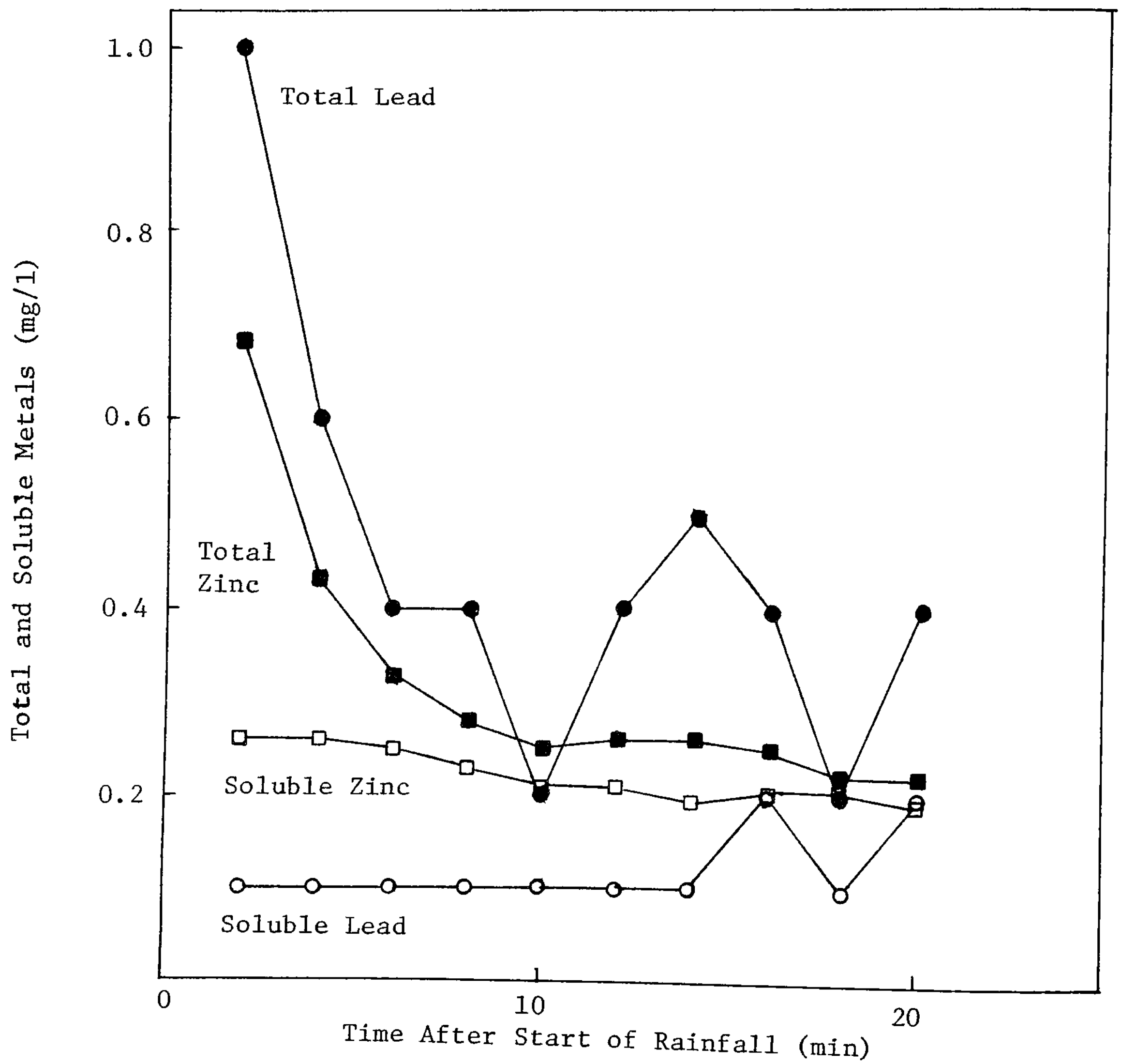
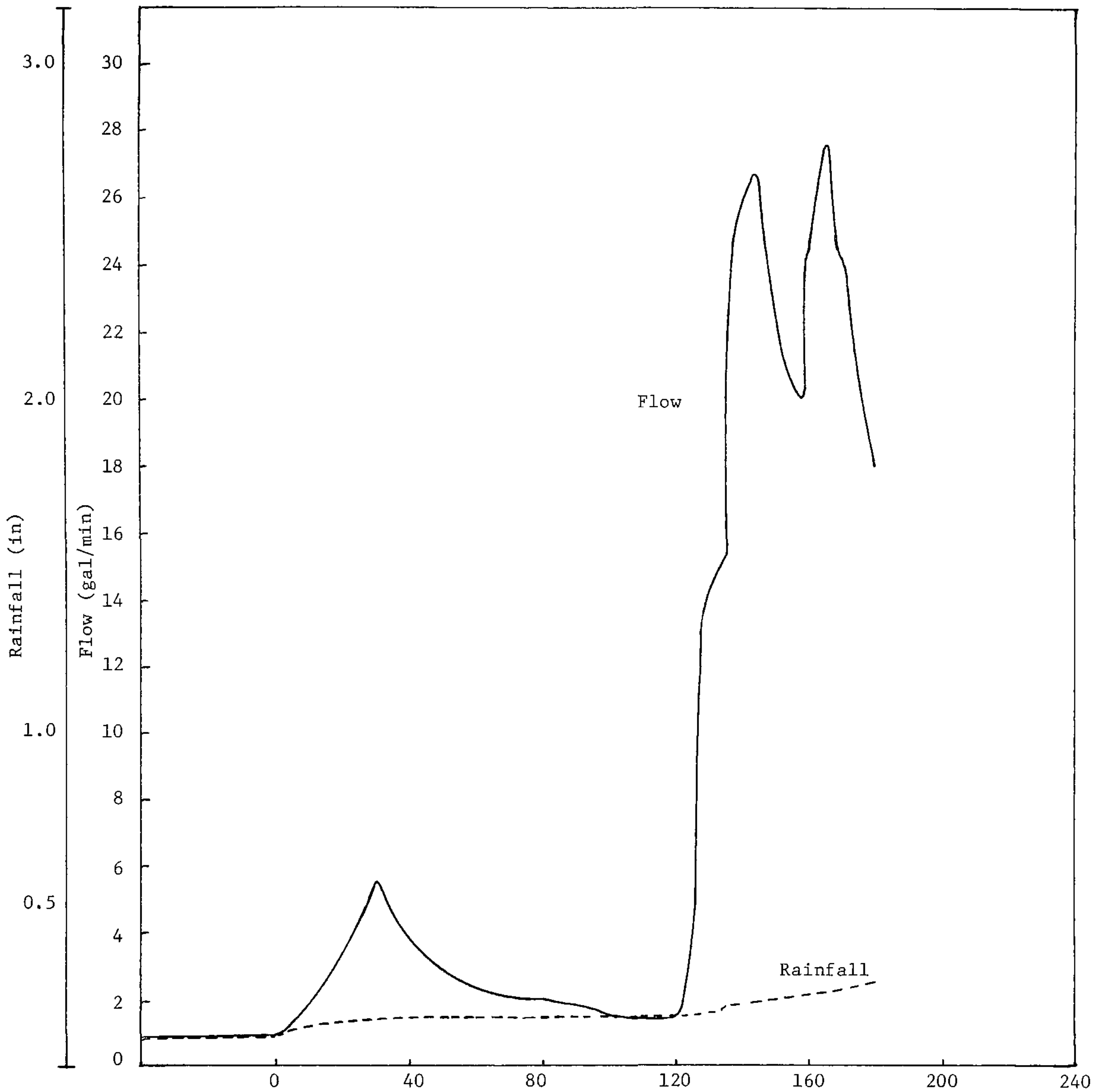


Figure 15 (continued)



(Outfall on Western End of I 495 Overpass at Northwest Branch)

Figure 16. Storm event of 21 August 1973

(a) A small amount of rainfall and low runoff flow rates were recorded over a 30-hour period prior to zero time.

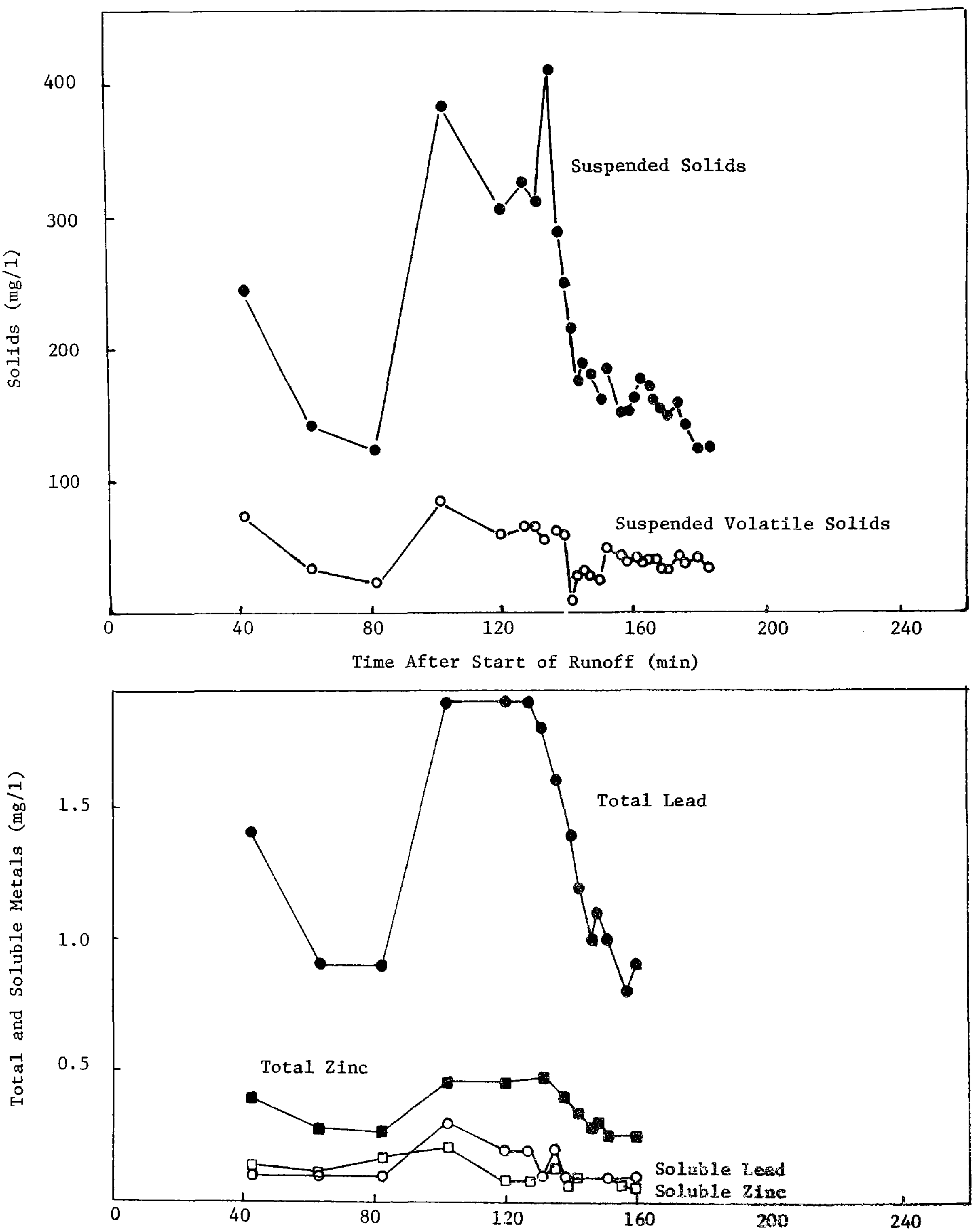
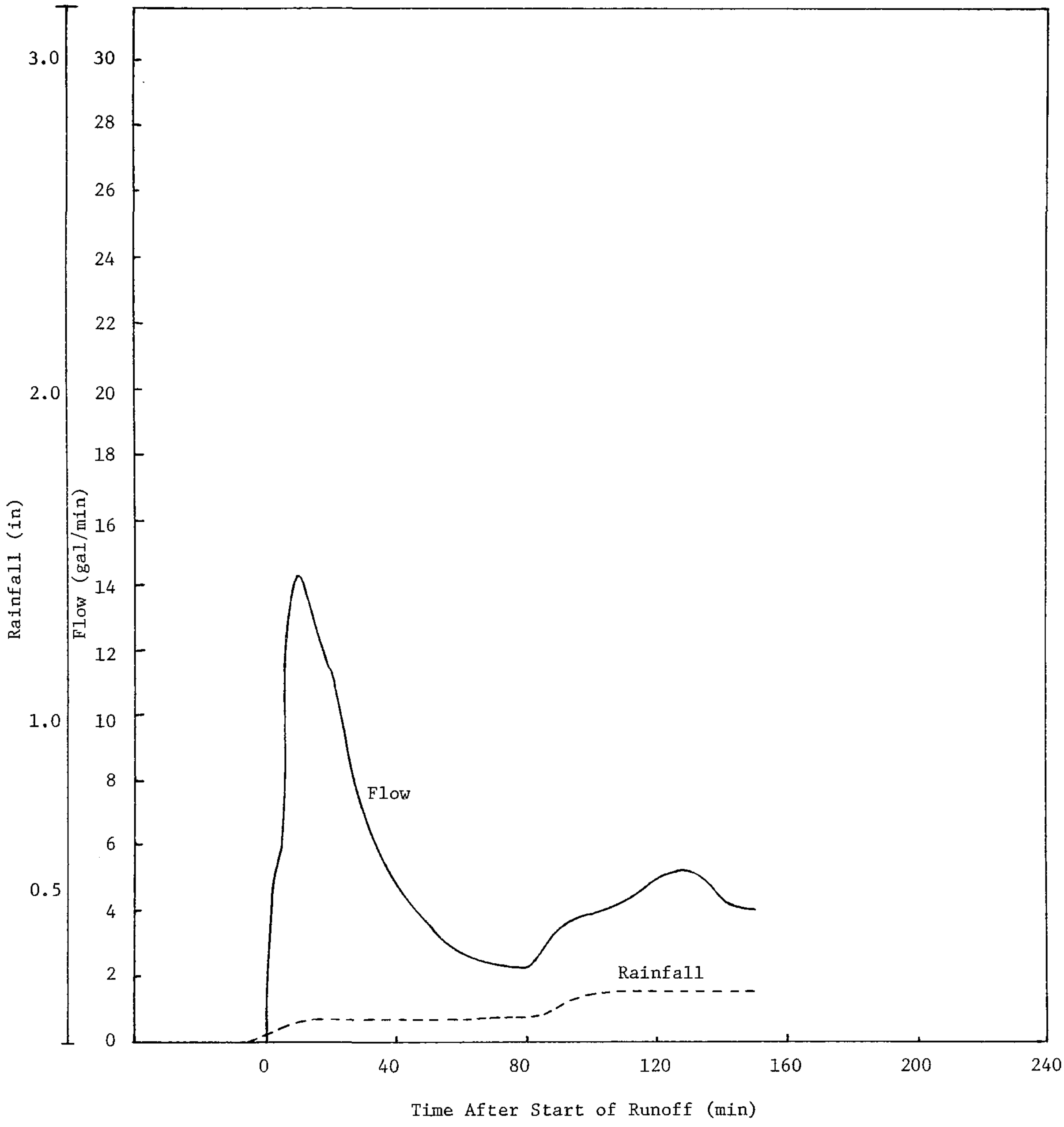


Figure 16 (continued)



(Outfall on Western End of I 495 Overpass at Northwest Branch)

Figure 17. Storm event of 2 September 1973

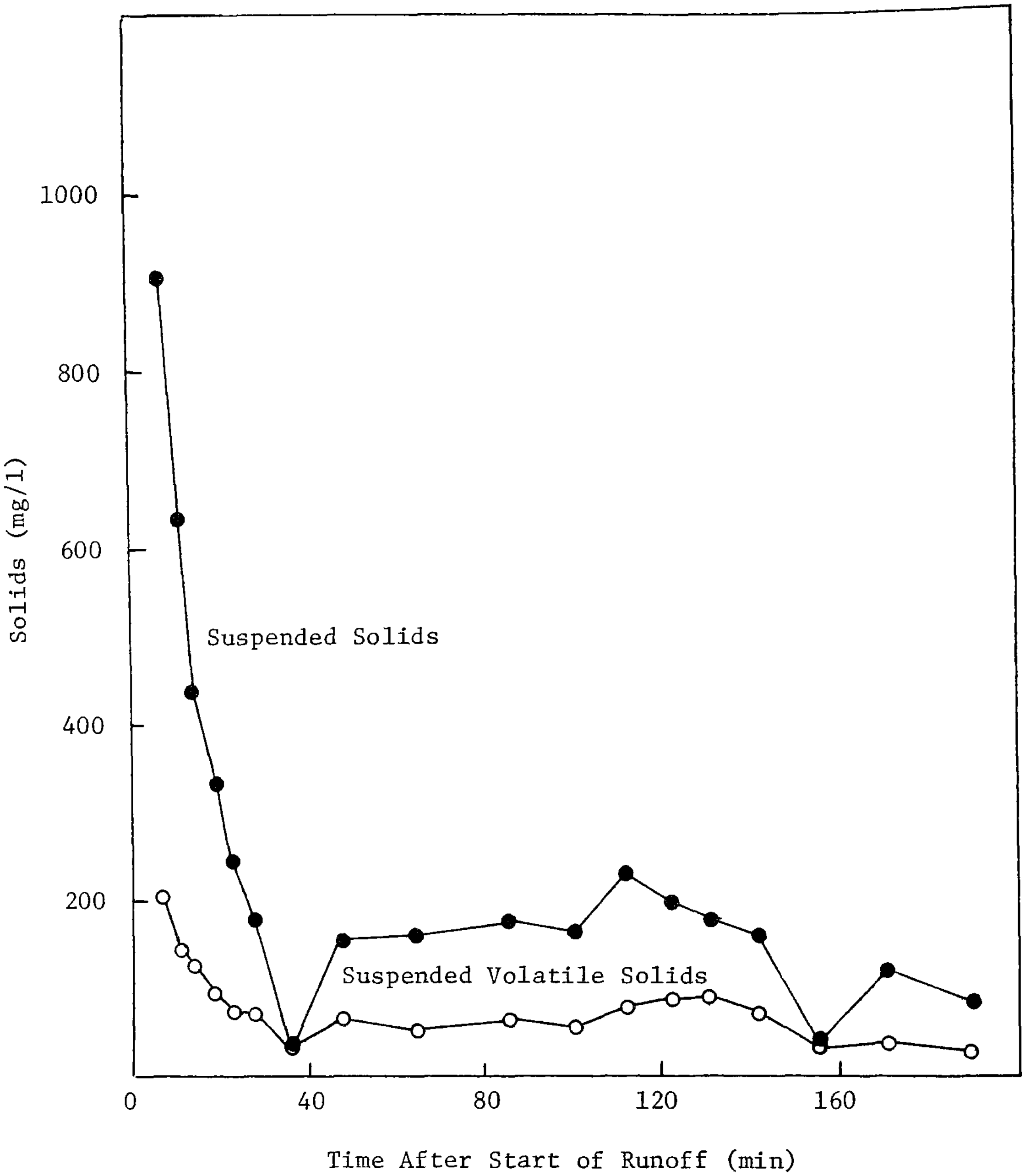


Figure 17 (continued)

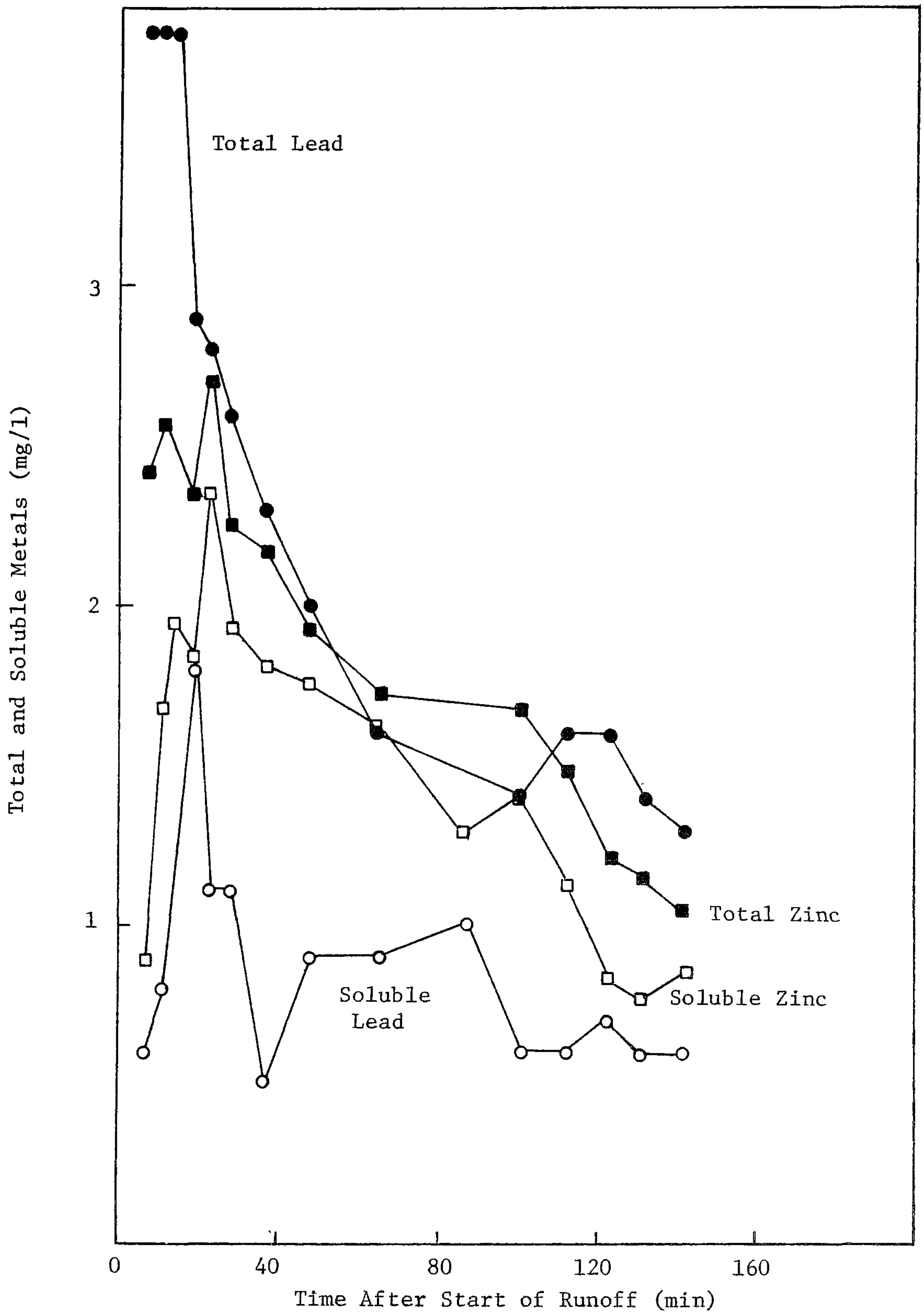
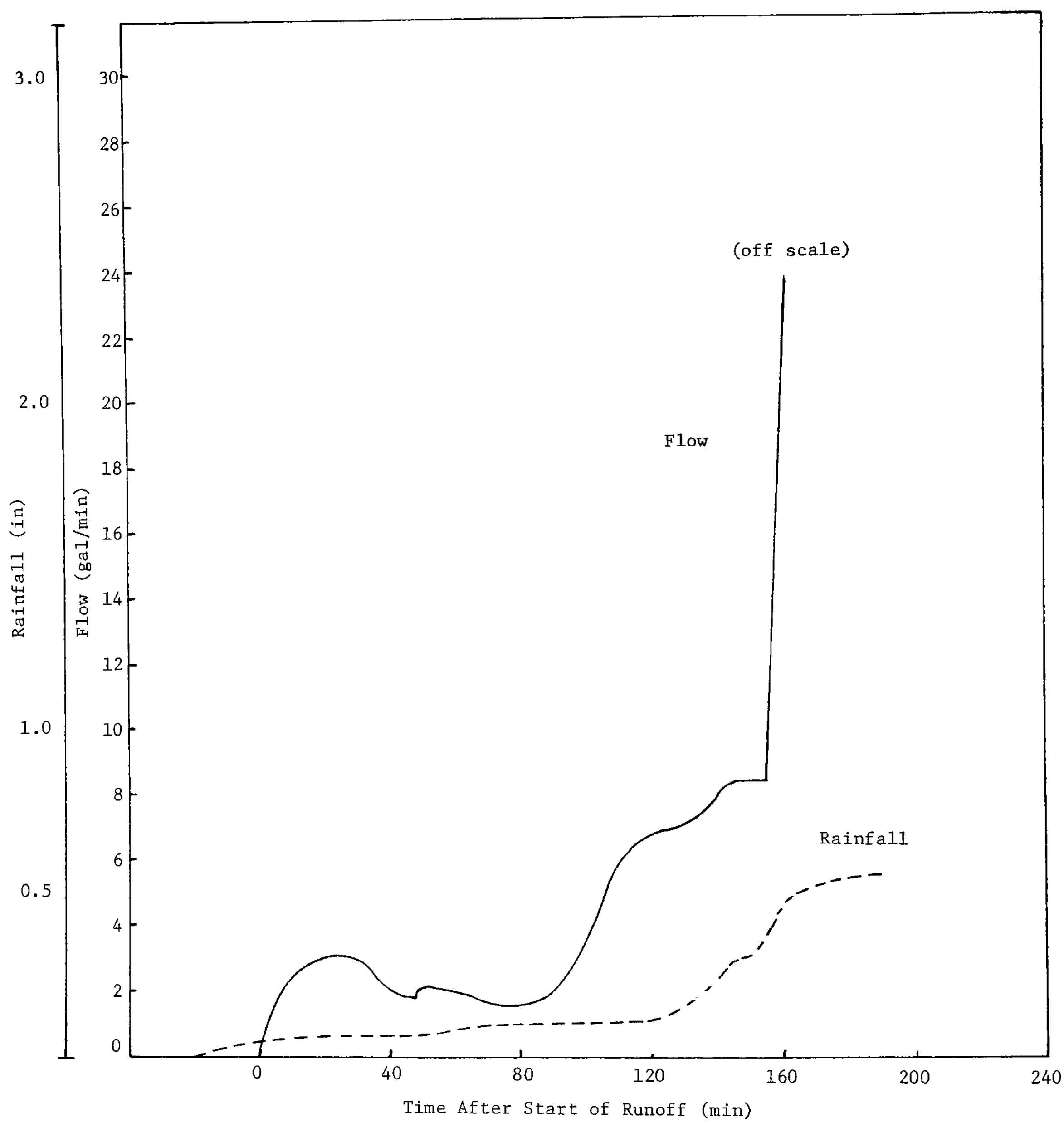


Figure 17 (continued)



(Outfall on Western End of I 495 Overpass at Northwest Branch)

Figure 18. Storm event of 14 September 1973

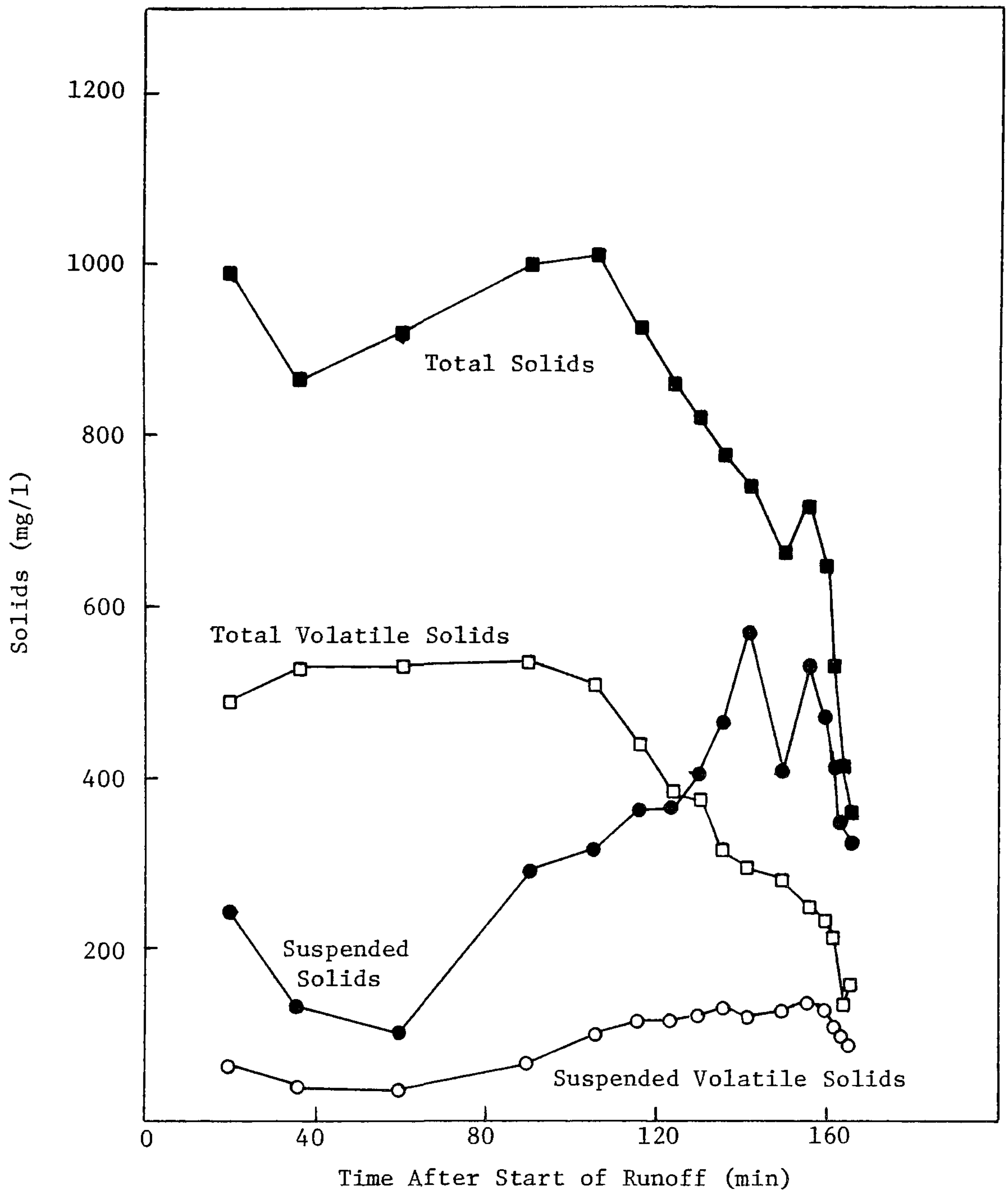


Figure 18 (continued)

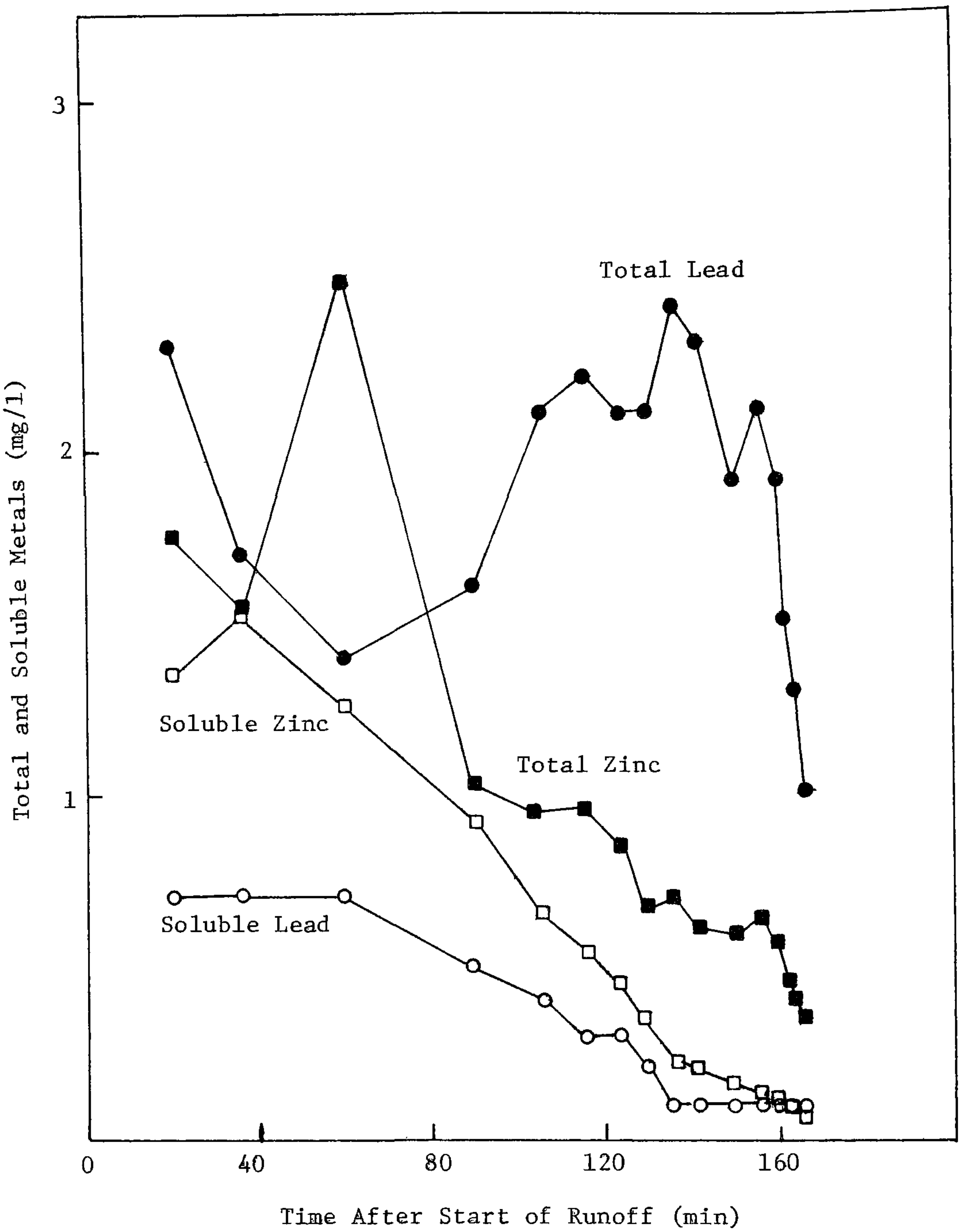
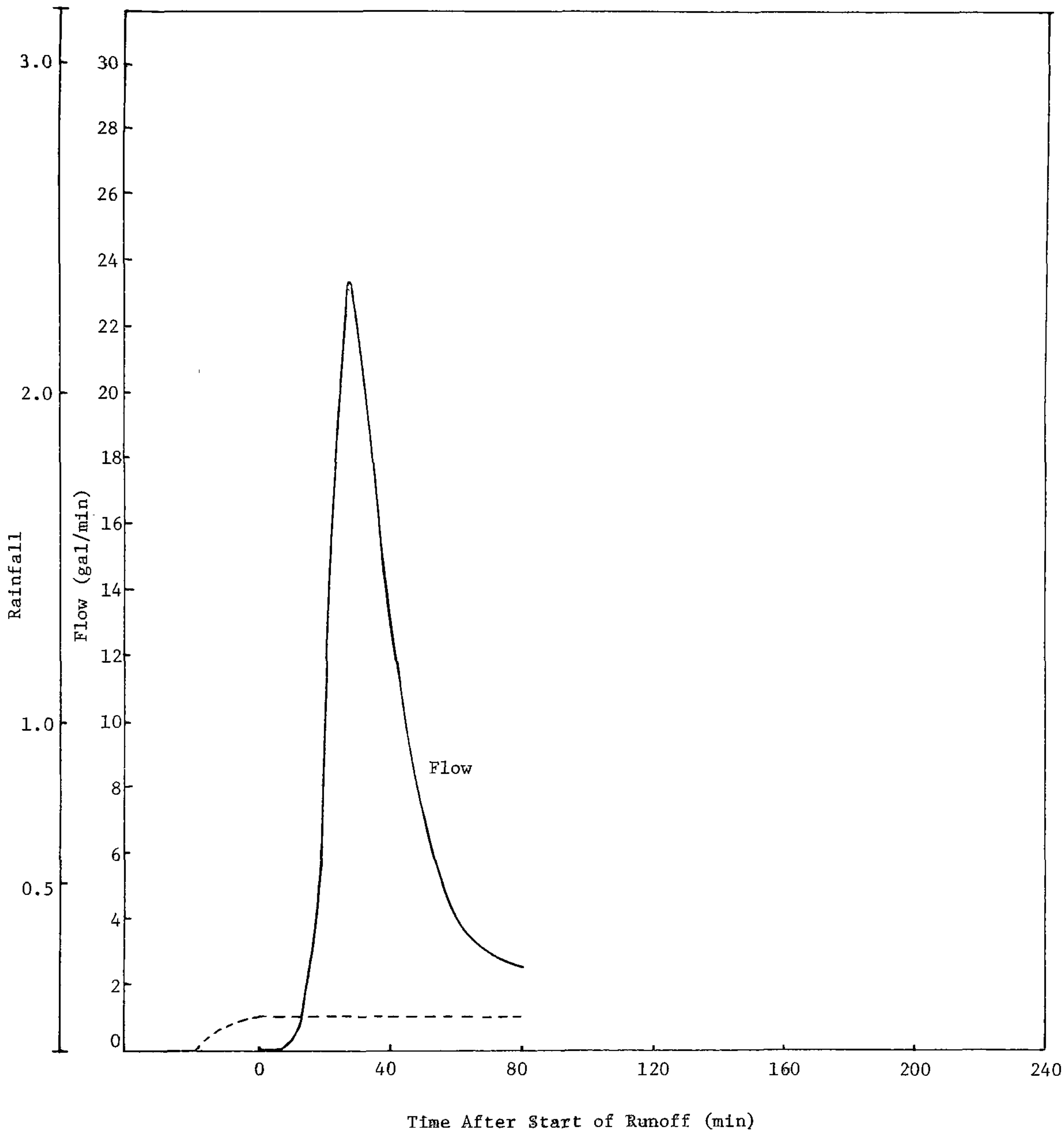


Figure 18 (continued)



(Outfall on Western End of I 495 Overpass at Northwest Branch)

Figure 19. Storm event of 18 September 1973

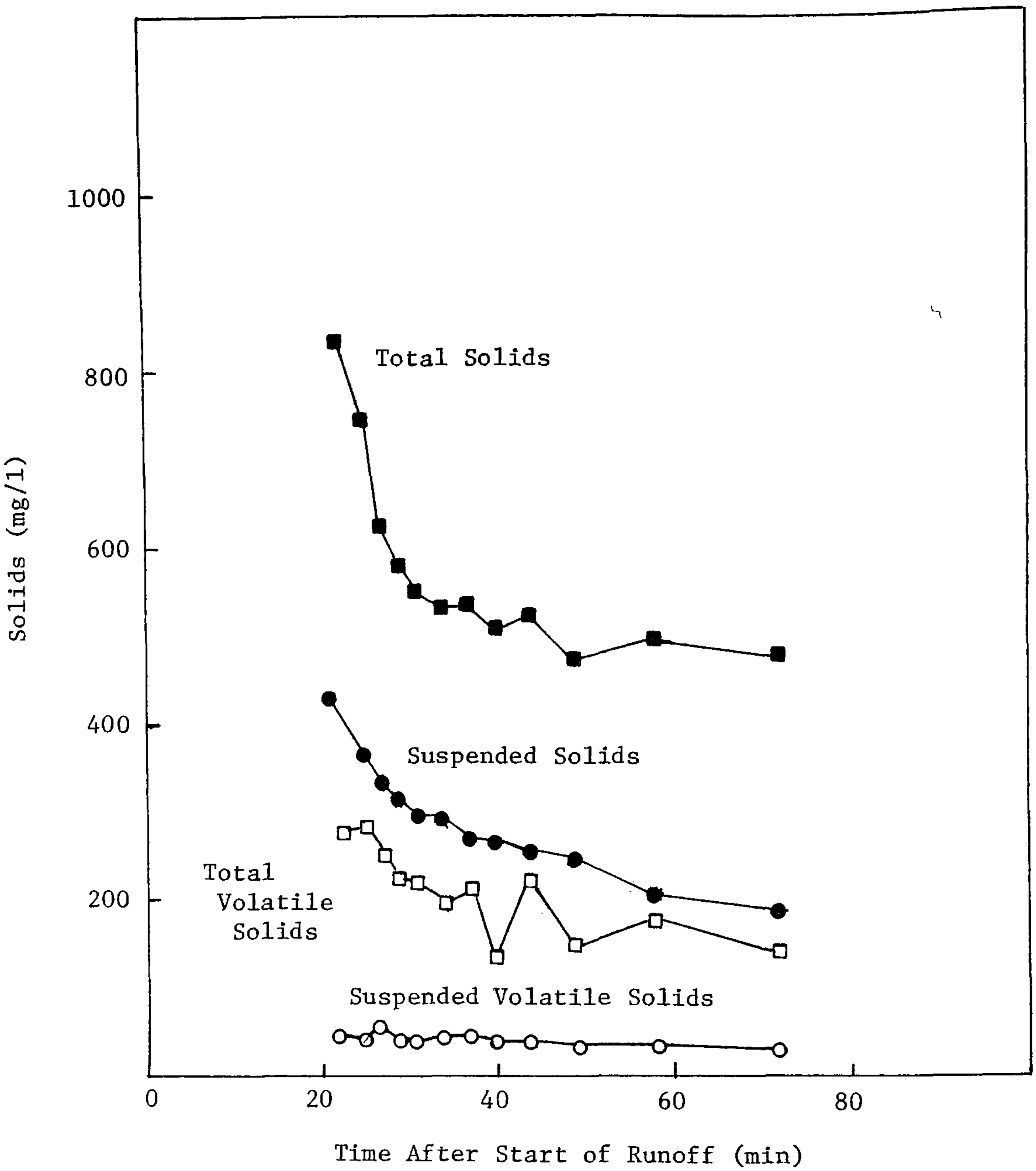


Figure 19 (continued)

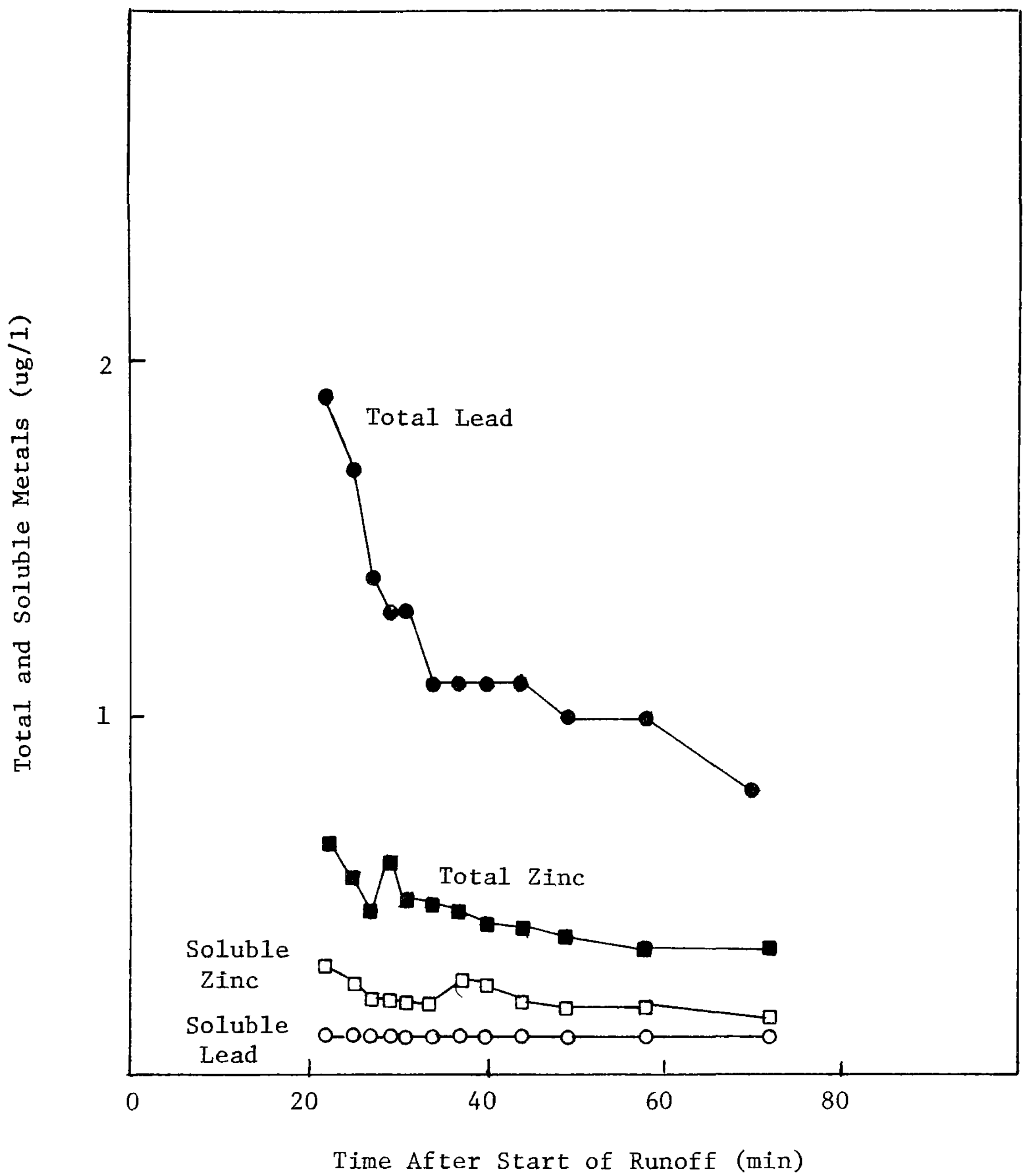
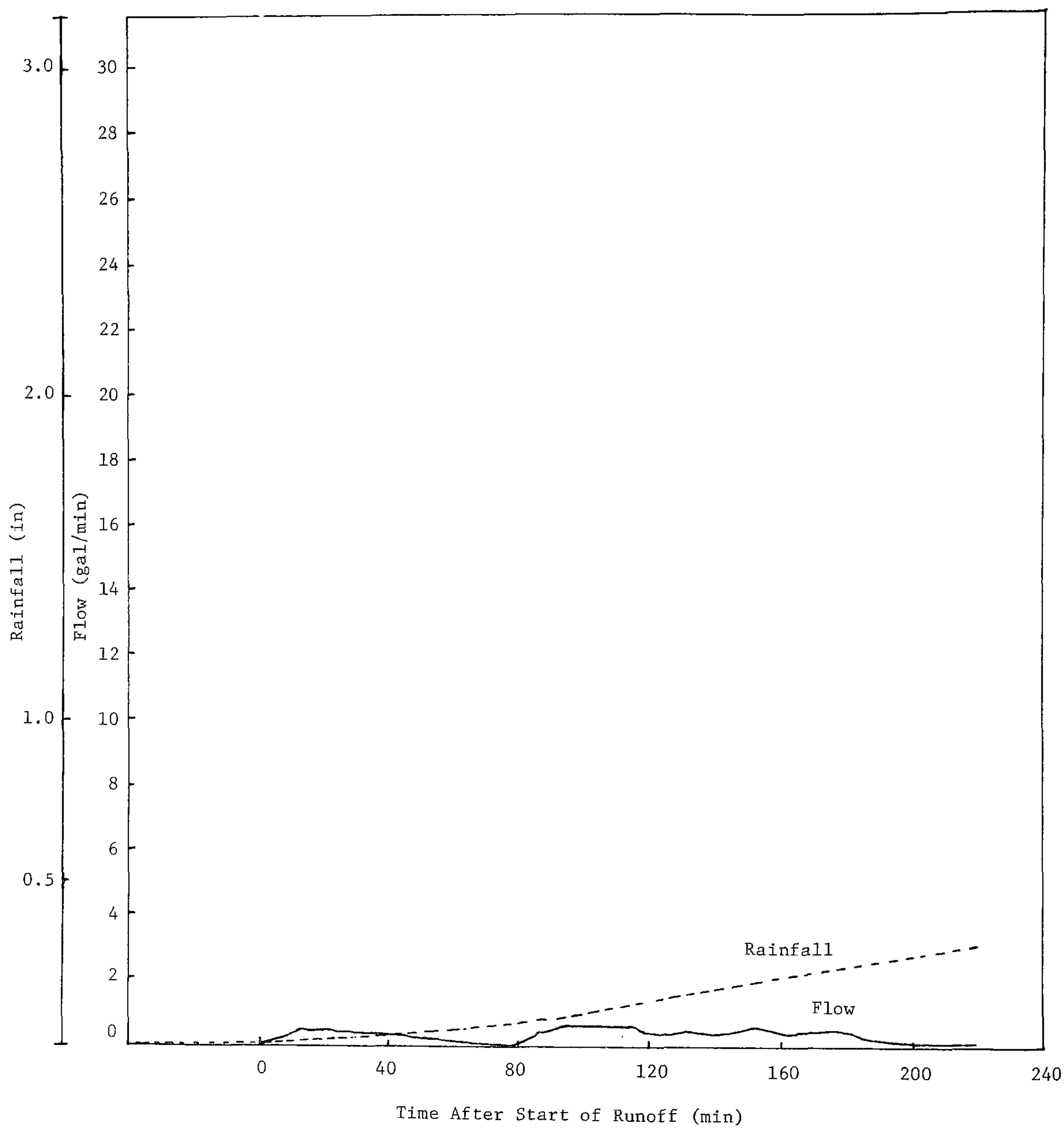
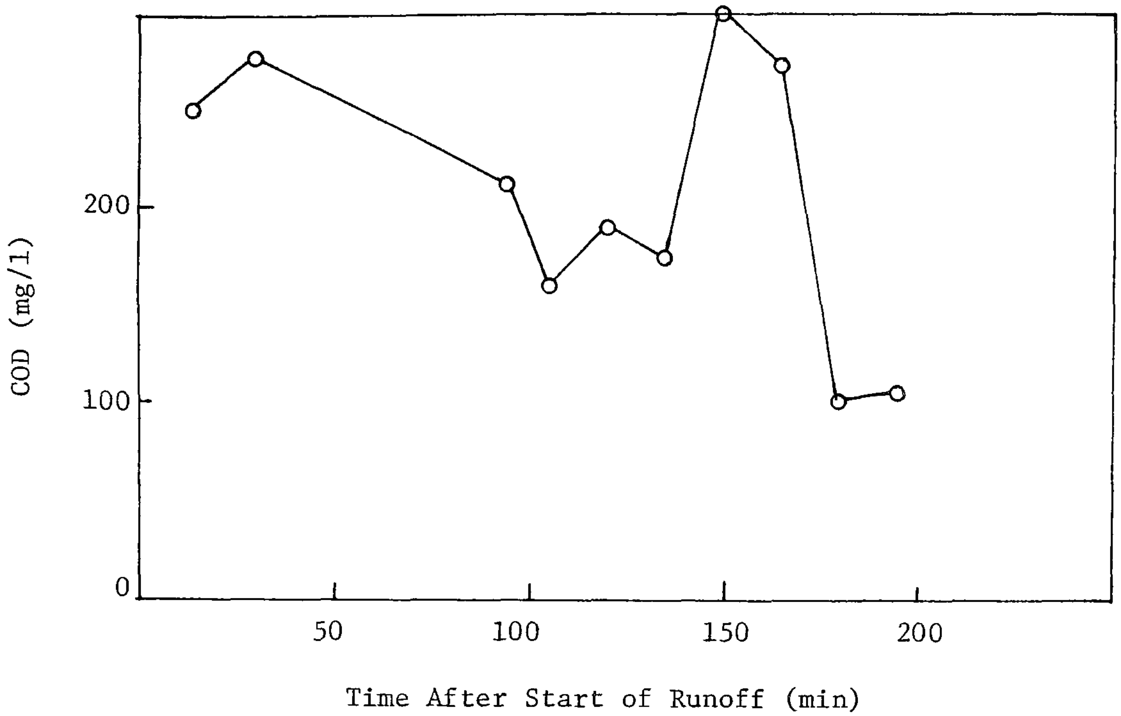


Figure 19 (continued)



(Outfall on Eastern End of I 495 Overpass at Northwest Branch)

Figure 20. Storm event of 6 September 1974



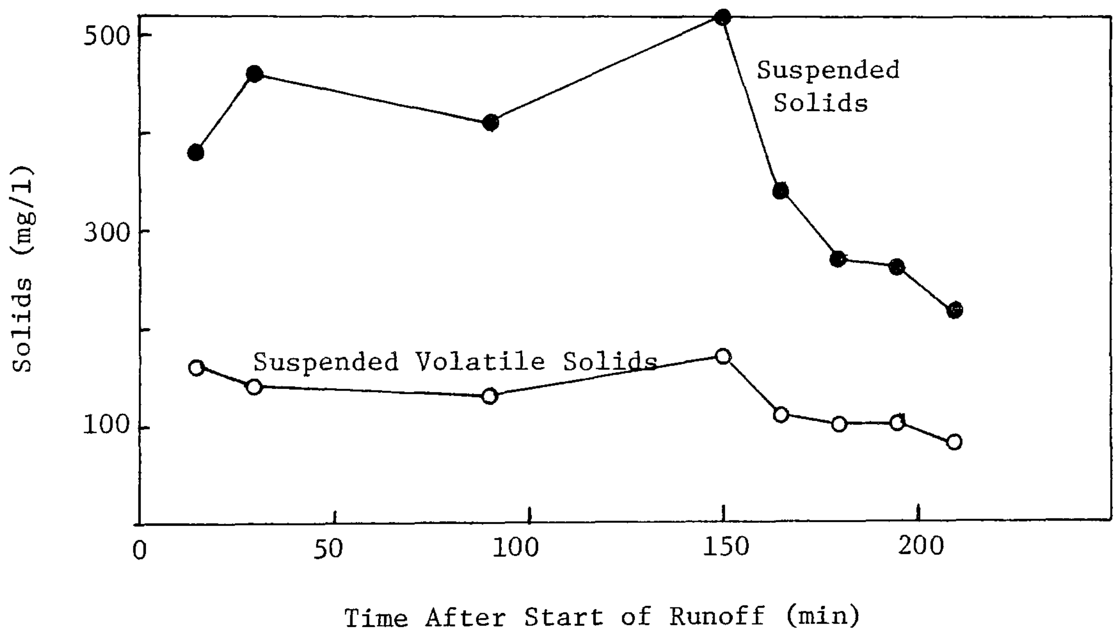


Figure 20 (continued)

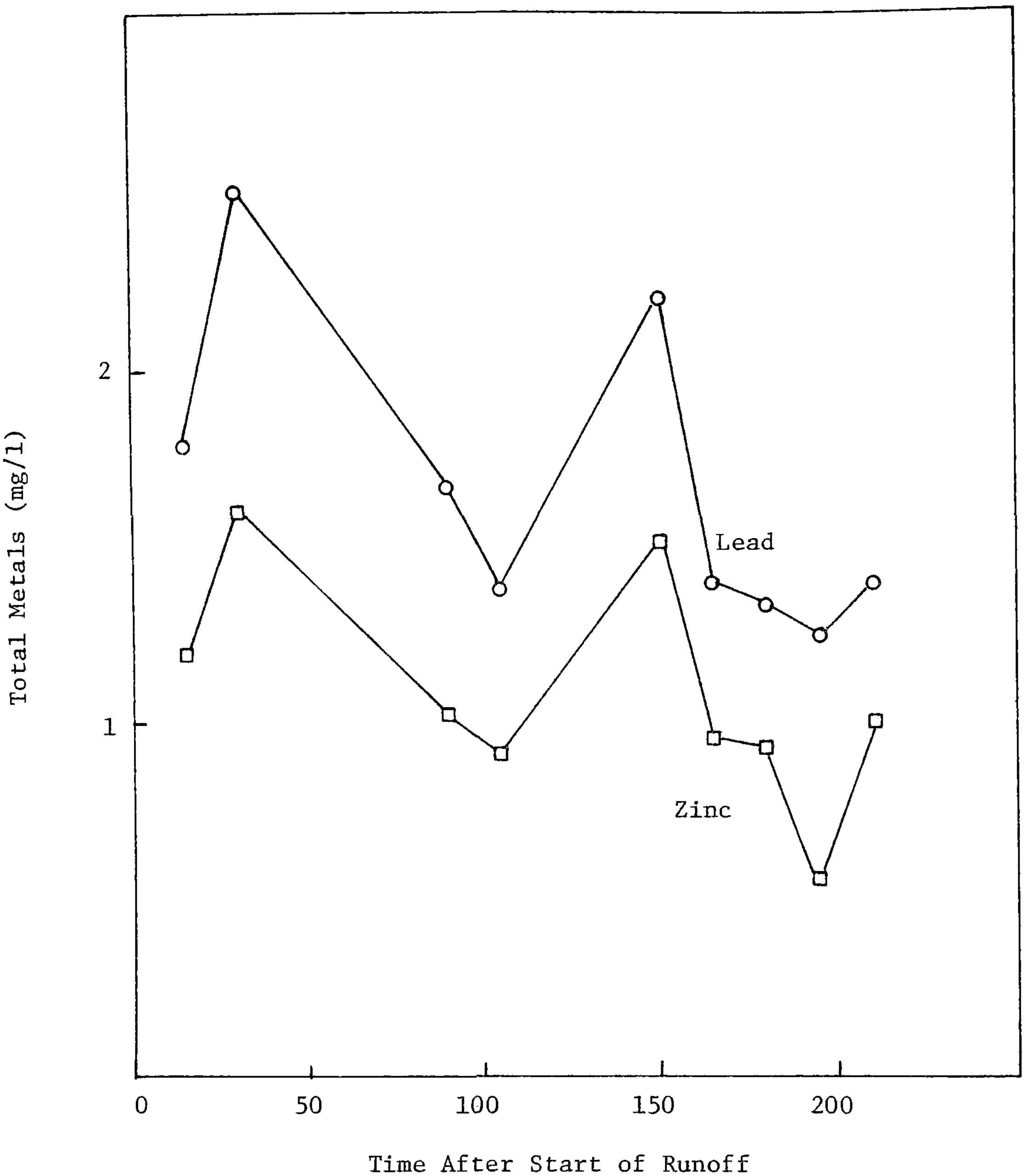


Figure 20 (continued)

SECTION IX

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SECTION IX

APPENDICES

APPENDIX A

SAMPLE INFORMATION

TABLE A-1. SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
1	L D&D --	INITIAL	17	7	72	I95	NO RAIN	-----
2	L D&D --	1 DAY	18	7	72	I95	NO RAIN	0
3	L D&D --	1 DAY	19	7	72	I95	NO RAIN	0
4	L D&D --	1 DAY	20	7	72	I95	NO RAIN	0
5	L D&D --	1 DAY	21	7	72	I95	NO RAIN	0
6	L D&D --	WK END	24	7	72	I95	NO RAIN	0
7	L D&D F	INITIAL	31	7	72	KEN AV R	NO RAIN	-----
8	L D&D F	1 DAY	1	8	72	KEN AV R	RAIN	84720
9	L D&D F	1 DAY	2	8	72	KEN AV R	NO RAIN	83940
10	L D&D F	1 DAY	3	8	72	KEN AV R	NO RAIN	83840
11	L D&D F	1 DAY	4	8	72	KEN AV R	RAIN	87260
12	L D&D F	WK END	7	8	72	KEN AV R	NO RAIN	208320
13	L D&D F	1 DAY	8	8	72	KEN AV R	NO RAIN	81720
14	L D&D --	INITIAL	31	7	72	KEN AV L	NO RAIN	-----
15	L D&D --	1 DAY	1	8	72	KEN AV L	RAIN	84720
16	L D&D --	1 DAY	2	8	72	KEN AV L	NO RAIN	83940
17	L D&D --	1 DAY	3	8	72	KEN AV L	NO RAIN	83840
18	L D&D --	1 DAY	4	8	72	KEN AV L	RAIN	87260
19	L D&D --	WK END	7	8	72	KEN AV L	NO RAIN	208320
20	L D&D --	1 DAY	8	8	72	KEN AV L	NO RAIN	81720
21	L D&D F	INITIAL	14	8	72	I495	NO RAIN	-----
22	L D&D F	1 DAY	15	8	72	I495	NO RAIN	109104

TABLE A-1 (CONTINUED). SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
23	L D&D F	1 DAY	16	8	72	I495	NO RAIN	96661
24	L D&D F	1 DAY	18	8	72	I495	RAIN	97266
25	L D&D F	WK END	21	8	72	I495	NO RAIN	299766
26	L D&D F	1 DAY	22	8	72	I495	NO RAIN	109104
27	L D&D --	INITIAL	11	9	72	LM PLAZA	NO RAIN	-----
28	L D&D --	1 DAY	12	9	72	LM PLAZA	NO RAIN	2440
29	L D&D --	1 DAY	14	9	72	LM PLAZA	NO RAIN	2459
30	L D&D --	1 DAY	15	9	72	LM PLAZA	RAIN	2364
31	L D&D --	WK END	18	9	72	LM PLAZA	NO RAIN	8128
32	L D&D --	1 DAY	20	9	72	LM PLAZA	NO RAIN	2614
33	L D&D F	INITIAL	25	9	72	KEN AV R	NO RAIN	-----
34	L D&D F	1 DAY	26	9	72	KEN AV R	NO RAIN	81760
35	L D&D F	1 DAY	29	9	72	KEN AV R	NO RAIN	86040
36	L D&D F	1 DAY	3	10	72	KEN AV R	NO RAIN	81220
37	L D&D --	INITIAL	25	9	72	KEN AV L	NO RAIN	-----
38	L D&D --	1 DAY	26	9	72	KEN AV L	NO RAIN	81760
39	L D&D --	1 DAY	29	9	72	KEN AV L	NO RAIN	86040
40	L D&D --	1 DAY	3	10	72	KEN AV L	NO RAIN	81220
41	L D&D --	INITIAL	16	10	72	I495	NO RAIN	-----
42	L D&D F	1 DAY	17	10	72	I495	NO RAIN	98430
43	L D&D F	1 DAY	18	10	72	I495	NO RAIN	110590
44	L D&D F	WK END	23	10	72	I495	NO RAIN	291002

TABLE A-1 (CONTINUED). SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
45	L D&D F	1 DAY	24	10	72	I495	NO RAIN	113623
46	L D&D F	1 DAY	25	10	72	I495	NO RAIN	110590
47	L D&D --	INITIAL	27	10	72	LM PLAZA	NO RAIN	-----
48	L D&D --	1 DAY	31	10	72	LM PLAZA	NO RAIN	2699
49	L D&D --	WK END	6	11	72	LM PLAZA	NO RAIN	8287
50	L D&D --	1 DAY	7	11	72	LM PLAZA	NO RAIN	2699
51	L D&D F	INITIAL	6	11	72	CAMP	NO RAIN	-----
52	L D&D F	1 DAY	7	11	72	CAMP	NO RAIN	5223
53	L D&D F	1 DAY	9	11	72	CAMP	NO RAIN	5210
54	L D&D F	1 DAY	10	11	72	CAMP	NO RAIN	5544
55	L D&D F	WK END	13	11	72	CAMP	NO RAIN	10853
56	L D&D F	INITIAL	27	11	72	N CAP R	NO RAIN	-----
57	L D&D F	1 DAY	28	11	72	N CAP R	NO RAIN	32926
58	L D&D F	1 DAY	29	11	72	N CAP R	NO RAIN	31052
59	L D&D F	WK END	4	12	72	N CAP R	NO RAIN	94102
60	L D&D F	1 DAY	5	12	72	N CAP R	NO RAIN	32926
61	L D&D --	INITIAL	8	1	73	KEN AV R	NO RAIN	-----
62	L D&D --	1 DAY	9	1	73	KEN AV R	NO RAIN	79108
63	L D&D --	1 DAY	10	1	73	KEN AV R	NO RAIN	78960
64	L D&D --	1 DAY	11	1	73	KEN AV R	NO RAIN	78996
65	L D&D --	1 DAY	12	1	73	KEN AV R	NO RAIN	85602
66	L D&D --	WK END	15	1	73	KEN AV R	NO RAIN	187804

TABLE A-1 (CONTINUED). SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
67	L D&D --	INITIAL	8	1	73	KEN AV L	NO RAIN	-----
68	L D&D --	1 DAY	9	1	73	KEN AV L	NO RAIN	79108
69	L D&D --	1 DAY	10	1	73	KEN AV L	NO RAIN	78960
70	L D&D --	1 DAY	11	1	73	KEN AV L	NO RAIN	78996
71	L D&D --	1 DAY	12	1	73	KEN AV L	NO RAIN	85602
72	L D&D --	WK END	15	1	73	KEN AV L	NO RAIN	187804
73	L D&D F	1 DAY	24	1	73	I495	NO RAIN	115162
74	L D&D F	1 DAY	25	1	73	I495	NO RAIN	135535
75	L D&D F	1 DAY	26	1	73	I495	NO RAIN	103117
76	L D&D F	1 DAY	30	1	73	I495	NO RAIN	109158
77	L D&D F	1 DAY	31	1	73	I495	NO RAIN	116162
78	L D&D F	INITIAL	5	2	73	N CAP R	NO RAIN	-----
79	L D&D F	1 DAY	6	2	73	N CAP R	NO RAIN	39132
80	L D&D F	4 DAY	13	2	73	N CAP R	NO RAIN	134400
81	L D&D --	3 DAY	16	2	73	N CAP R	RAIN	116501
82	L D&D F	4 DAY	20	2	73	N CAP R	NO RAIN	117792
83	L D&D F	1 DAY	21	2	73	N CAP R	NO RAIN	36905
84	L D&D F	INITIAL	5	2	73	N CAP L	NO RAIN	-----
85	L D&D F	1 DAY	6	2	73	N CAP L	NO RAIN	39132
86	L D&D F	4 DAY	13	2	73	N CAP L	NO RAIN	134400
87	L D&D --	3 DAY	16	2	73	N CAP L	RAIN	116501
88	L D&D F	4 DAY	20	2	73	N CAP L	NO RAIN	117792

TABLE A-1 (CONTINUED). SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
89	L D&D F	1 DAY	21	2	73	N CAP L	NO RAIN	36905
90	L D&D F	INITIAL	22	2	73	CAMP	NO RAIN	-----
91	L D&D F	4 DAY	26	2	73	CAMP	RAIN	18037
92	L D&D F	1 DAY	27	2	73	CAMP	NO RAIN	5324
93	L D&D F	1 DAY	28	2	73	CAMP	NO RAIN	5773
94	L D&D F	1 DAY	1	3	73	CAMP	NO RAIN	6090
95	L D&D F	INITIAL	5	3	73	BW PKWY	NO RAIN	-----
96	L D&D F	1 DAY	9	3	73	BW PKWY	NO RAIN	72045
97	L D&D F	1 DAY	13	3	73	BW PKWY	NO RAIN	68602
98	L D&D F	1 DAY	14	3	73	BW PKWY	NO RAIN	64540
99	L D&D F	INITIAL	27	3	73	KEN AV R	NO RAIN	-----
100	L D&D F	1 DAY	28	3	73	KEN AV R	NO RAIN	84060
101	L D&D F	1 DAY	29	3	73	KEN AV R	NO RAIN	84740
102	L D&D --	INITIAL	27	3	73	KEN AV L	NO RAIN	-----
103	L D&D --	1 DAY	28	3	73	KEN AV L	NO RAIN	84060
104	L D&D --	1 DAY	29	3	73	KEN AV L	NO RAIN	84740
105	L D&D F	INITIAL	9	4	73	I495	NO RAIN	-----
106	L D&D F	1 DAY	11	4	73	I495	NO RAIN	111807
107	L D&D F	1 DAY	12	4	73	I495	NO RAIN	105000
108	L D&D F	WK END	16	4	73	I495	NO RAIN	299882
109	L D&D F	INITIAL	23	4	73	N CAP R	NO RAIN	-----
110	L D&D F	1 DAY	1	5	73	N CAP R	NO RAIN	52059

TABLE A-1 (CONTINUED). SAMPLE IDENTIFICATION AND TOTAL TRAFFIC DATA

SAMPLE NUMBER	SAMPLE FRACTION	SAMPLE TYPE	DATE DAY	MO	YR	SAMPLING SITE	SAMPLING CONDITIONS	TRAFFIC AXLES
111	L D&D F	1 DAY	2	5	73	N CAP R	NO RAIN	49714
112	L D&D F	INITIAL	10	5	73	BW PKWY	NO RAIN	-----
113	L D&D F	1 DAY	11	5	73	BW PKWY	NO RAIN	79444
114	L D&D F	WK END	14	5	73	BW PKWY	NO RAIN	240584
115	L D&D F	1 DAY	17	5	73	BW PKWY	NO RAIN	80984
116	L D&D F	1 DAY	22	5	73	CAMP	NO RAIN	6361
117	L D&D F	WK END	4	6	73	CAMP	NO RAIN	20657
118	L D&D F	1 DAY	8	6	73	CAMP	NO RAIN	7664
119	L D&D F	INITIAL	9	7	73	CAMP	NO RAIN	-----
120	L D&D F	1 DAY	10	7	73	CAMP	NO RAIN	5351
121	L D&D F	1 DAY	12	7	73	CAMP	NO RAIN	5858
122	L D&D F	1 DAY	17	7	73	CAMP	NO RAIN	5226
123	L D&D F	INITIAL	23	7	73	N CAP R	NO RAIN	-----
124	L D&D F	1 DAY	24	7	73	N CAP R	NO RAIN	30728
125	L D&D F	1 DAY	27	7	73	N CAP R	NO RAIN	40200
126	L D&D F	WK END	30	7	73	N CAP R	NO RAIN	118039
127	L D&D F	1 DAY	31	7	73	N CAP R	NO RAIN	49531

TABLE A-2. SCHEDULE OF ROADWAY SAMPLING PERIODS - ANTECEDENT CLEANING INFORMATION

Roadway Sites	Sampling Period	Comments
I 95	17 July - 24 July 1972	This is an unopened section of roadway and has never been swept.
Kenilworth Avenue	31 July - 8 Aug. 1972	Information on the most recent sweeping prior to sampling was not available. The roadway site was not swept during the sampling period (the sweeper was diverted on 2 August '72 and bypassed the area.
I 495	14 Aug. - 22 Aug. 1972	The site was not swept during this sampling period. The area was last cleaned on 8 August 1972 prior to the sampling period.
Loehmann's Plaza	11 Sep. - 20 Sep. 1972	By agreement with maintenance personnel, the area was not cleaned during this period. Most recent previous cleaning was 5 September 1972.
Kenilworth Avenue	25 Sep. - 2 Oct. 1972	The most recent antecedent sweeping was on 20 September 1972 and, by agreement, the area was not swept again before 7 October 1972.
I 495	16 Oct. - 25 Oct. 1972	The area was swept on 5 October 1972. By agreement with the Resident Maintenance Engineer, the site was bypassed on the 19th of October.
Loehmann's Plaza	27 Oct. - 7 Nov. 1972	The site was cleaned on 22 October 1972 and bypassed during the sampling period.
CAMP Station	6 Nov. - 13 Nov. 1972	The area was swept on 24 October 1972 and scheduled for sweeping again on 8 November 1972. However, it was arranged to bypass this site until 15 November 1972.
N. Capitol St.	27 Nov. - 5 Dec. 1972	The site was last cleaned on 25 October 1972 and bypassed during the sampling period.

TABLE A-2 (CONTINUED). SCHEDULE OF ROADWAY SAMPLING PERIODS - ANTECEDENT CLEANING INFORMATION

Roadway Sites	Sampling Period	Comments
Kenilworth Avenue	8 Jan. - 15 Jan. 1973	The area was last swept 30 Nov. 1972 and bypassed during the sampling period.
I 495	23 Jan. - 31 Jan. 1973	The area was last swept on 17 January 1973 and bypassed during the sampling period.
N. Capitol St.	5 Feb. - 21 Feb. 1973	The site was not cleaned since our last sample collection there on 5 December 1973 and was by-passed during the sampling period.
CAMP Station	22 Feb. - 1 Mar. 1973	The site was last swept on 21 Feb. 1973 and was bypassed during the sampling period.
Balt.-Wash. Pkwy.	5 Mar. - 14 Mar. 1973	This site is not swept except under unusual conditions.
Kenilworth Avenue	27 Mar. - 29 Mar. 1973	The area was last swept on 19 March 1973 and bypassed during the sampling period.
I 495	9 April - 16 April 1973	The area was last swept on 29 March 1973 and bypassed during the sampling period.
N. Capitol St.	23 April - 4 May 1973	The site was last swept on 16 April 1973 and bypassed during the sampling period.
Balt.-Wash. Pkwy.	10 May - 17 May 1973	This site is not swept except under unusual conditions.
CAMP Station	22 May - 8 June 1973	The site was last swept on 25 April 1973 and bypassed during the sampling period.
CAMP Station	9 July - 17 July 1973	The site was last swept in June 1973 and bypassed during the sampling period.
N. Capitol St.	23 July-31 July 1973	The site was last cleaned on 16 April 1973 and bypassed during the sampling period.

TABLE A-3. TOTAL TRAFFIC BREAKDOWN FOR ROADWAY SAMPLING PERIODS

		Traffic Breakdown (%)				
Location	Sampling Period	Autos	Buses	Panel & Pickup Trucks	Single Unit Trucks	Semi Tractor & Trailor
I 95	17 - 24 July 72	---No Traffic---				
Kenilworth Ave.	31 July - 8 Aug. 72	84.8	0.8	7.7	5.0	1.7
I 495	14 - 22 Aug. 72	77.7	0.3	9.2	6.9	5.9
Loehmann's Plaza	11 - 20 Sept. 72	93.2	0.0	4.5	1.6	0.7
Kenilworth Ave.	25 Sept. - 3 Oct. 72	88.0	0.5	7.0	3.1	1.4
I 495	16 - 25 Oct. 72	76.2	0.3	10.1	8.0	5.4
Loehmann's Plaza	27 Oct. - 7 Nov. 72	91.2	0.0	5.1	2.8	0.9
CAMP Station	6 - 13 Nov. 72	77.8	0.6	9.8	10.1	1.7
N. Capitol St.	27 Nov. - 5 Dec. 72	83.0	2.0	6.4	7.0	1.6
Kenilworth Ave.	8 - 15 Jan. 73	85.0	0.6	7.7	5.4	1.3
I 495	24 - 31 Jan. 73	79.2	0.2	9.5	6.2	4.9
N. Capitol. St.	5 - 21 Feb. 73	87.0	1.3	4.9	5.6	1.2
CAMP Station	22 Feb. - 1 Mar. 73	73.9	1.8	11.0	11.9	1.4
Balto.-Wash. Pkwy.	5 - 14 Feb. 73	89.4	3.2	7.3	0.1	0.0
Kenilworth Ave.	27 - 29 March 1973	83.2	0.6	8.8	6.4	1.0
I 495	9 - 16 April 1973	80.3	0.3	9.9	5.1	4.4
N. Capitol St.	23 April - 2 May 73	89.8	0.7	6.0	3.0	0.5
Balto.-Wash. Pkwy.	10 - 17 May 73	94.3	1.7	3.8	0.2	0.0
CAMP Station	22 May - 8 June 73	89.7	0.7	5.4	2.9	1.3
CAMP Station	9 July - 17 July 73	89.8	0.9	5.4	2.7	1.2
N. Capitol St.	23 July - 31 July 73	87.0	1.6	5.5	5.2	0.7

APPENDIX B

ANALYSES OF ROADWAY SAMPLES

TABLE B-1. ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
1L	123.0	75	0.1	0.26	10.6
2L	2.0	1	240.4	---	---
3L	0.3	0	135.4	---	---
4L	0.1	0	187.8	---	---
5L	0.2	0	276.9	---	---
6L	0.5	0	36.2	---	---
7L	724.5	6700	835.1	0.59	229.9
8L*	17.3	15	89.8	0.50	55.9
9L	87.8	250	48.2	1.70	94.3
10L	62.3	150	191.1	0.31	112.6
11L*	144.7	300	48.3	0.26	76.3
12L	94.5	100	31.4	0.28	30.7
13L	712.5	1000	119.4	0.36	98.2
14L	943.9	680	49.9	0.36	38.3
15L*	26.8	100	396.7	1.49	40.6
16L	302.9	350	130.0	2.12	38.7
17L	532.8	700	176.5	0.36	30.6
18L*	1340.6	1400	114.6	0.33	18.1
19L	209.3	300	150.3	0.20	191.3
20L	722.9	600	91.0	0.38	19.1
21L	243.2	200	74.5	0.39	40.4
22L	127.0	100	198.2	1.08	90.6

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-1 (CONTINUED). ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
23L	130.6	100	130.0	1.03	109.3
24L*	207.8	200	30.1	1.43	48.8
25L	155.0	90	118.8	2.70	63.9
26L	63.4	50	90.4	2.60	46.3
27L	103.9	470	835.0	18.80	333.3
28L	53.3	350	843.0	14.88	157.3
29L	126.5	550	900.6	11.66	377.1
30L*	25.4	300	765.6	16.45	463.9
31L	43.4	300	845.7	16.99	646.4
32L	53.2	300	863.1	16.48	929.1
33L	746.8	715	247.3	3.79	78.8
34L	117.4	175	386.7	5.26	167.7
35L	80.5	200	792.5	3.71	131.7
36L	75.3	175	214.1	11.26	149.3
37L	1846.6	1200	209.9	4.75	60.2
38L	160.2	175	565.0	1.37	191.1
39L	162.9	175	307.5	5.55	154.6
40L	249.3	250	184.3	14.57	265.2
41L	1933.7	1600	550.8	15.94	144.5
42L	179.1	200	540.2	20.20	185.7
43L	130.8	250	132.7	18.24	175.9
44L	529.3	565	60.3	9.39	254.7

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-1 (CONTINUED). ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
45L	139.2	275	669.3	7.61	353.8
46L	174.1	350	278.1	11.49	262.6
47L	116.6	625	868.9	9.85	422.2
48L	39.7	300	844.5	11.95	331.8
49L	175.6	800	845.4	15.54	1063.1
50L	119.2	350	821.3	18.46	978.6
51L	3901.1	3000	758.4	16.88	1033.0
52L	361.7	550	329.6	13.43	509.4
53L	852.5	2000	928.2	18.29	725.0
54L	713.2	1400	592.5	13.08	653.4
55L	920.7	1450	345.8	14.33	918.4
56L	173.9	350	545.2	8.71	918.8
57L	207.2	450	384.6	8.71	436.7
58L	68.5	200	471.9	9.99	820.7
59L	221.8	250	384.8	10.29	699.7
60L	158.7	325	744.8	10.60	1036.4
61L	3452.6	2500	177.8	1.42	109.4
62L	452.4	300	106.1	1.93	60.8
63L	268.6	150	485.0	2.02	204.1
64L	246.7	300	564.5	1.62	97.7
65L	157.2	150	270.0	1.28	54.2
66L	183.8	350	241.3	2.70	253.2

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-1 (CONTINUED). ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
67L	7428.0	6400	52.6	3.58	132.7
68L	371.8	400	128.8	1.46	140.1
69L	157.9	200	204.4	1.32	137.2
70L	181.5	250	238.5	1.71	247.9
71L	316.8	200	125.2	1.91	119.8
72L	252.6	250	206.0	1.33	130.5
73L	336.4	150	137.8	2.90	69.9
74L	224.3	175	316.1	2.40	58.1
75L	181.6	150	236.9	1.99	135.5
76L	132.1	150	266.0	2.52	115.2
77L	82.6	75	177.6	2.83	130.5
78L	782.1	800	474.0	3.36	139.9
79L	278.8	150	310.0	2.88	151.3
80L	436.8	900	305.9	11.00	156.2
81L*	372.7	400	679.2	6.34	113.3
82L	174.6	200	168.9	7.48	104.1
83L	66.8	100	257.8	6.67	396.0
84L	782.1	800	252.5	3.71	130.6
85L	90.5	100	457.4	2.46	217.5
86L	177.1	200	100.8	4.07	145.7
87L*	257.7	200	642.9	3.09	77.0
88L	118.5	150	244.7	3.80	297.0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-1 (CONTINUED). ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
89L	52.2	80	504.4	4.84	337.0
90L	12388.2	7900	65.1	3.51	87.2
91L*	1367.4	1300	220.5	7.61	136.9
92L	511.4	500	163.7	1.60	364.9
93L	378.6	400	225.2	8.34	446.4
94L	534.5	480	65.2	7.54	459.4
95L	6206.8	3750	47.1	1.76	399.0
96L	431.3	350	32.3	5.34	410.2
97L	74.2	150	109.4	7.35	366.4
98L	84.0	65	29.5	2.92	279.5
99L	884.9	600	172.6	6.88	79.8
100L	338.2	300	105.3	5.51	94.4
101L	158.6	200	111.3	4.09	145.3
102L	1365.8	1200	10.4	5.16	164.1
103L	364.1	400	75.4	5.20	386.2
104L	274.4	160	73.3	2.92	310.4
105L	264.9	150	48.0	8.71	170.6
106L	179.2	150	150.3	12.40	242.7
107L	156.7	150	262.2	15.56	227.1
108L	453.9	250	85.4	16.23	141.2
109L	1859.8	5000	125.4	6.98	255.0
110L	122.5	350	624.7	16.70	235.5

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-1 (CONTINUED). ANALYSES OF LITTER

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)
111L	2307.8	3100	511.6	14.19	333.0
112L	2863.3	1800	49.9	5.78	405.9
113L	283.8	200	23.0	16.01	271.9
114L	203.6	150	21.0	14.36	401.3
115L	256.5	200	30.7	22.48	370.7
116L	426.5	800	297.7	10.10	321.4
117L	378.2	400	71.1	11.76	145.9
118L	203.6	150	151.1	9.54	335.1
119L	1341.5	800	209.0	5.76	369.1
120L	369.1	400	212.0	11.41	328.1
121L	246.8	400	155.5	25.18	366.7
122L	284.3	200	290.8	9.19	254.0
123L	211.6	800	377.9	16.31	268.8
124L	45.3	75	116.5	17.80	371.4
125L	296.4	350	553.5	24.44	562.0
126L	479.6	800	349.3	21.40	648.2
127L	446.1	800	201.7	16.65	571.2

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2. ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
1D	934.8	1250	93.1	2.88	69.8	0.6
2D	122.8	135	106.6	2.51	170.0	0.6
3D	94.5	110	129.4	4.67	169.5	2.4
4D	54.8	30	94.9	6.31	185.9	15.2
5D	91.0	75	115.0	7.38	222.3	7.3
6D	58.4	45	149.3	8.19	248.0	16.9
7D	2033.2	6060	34.9	1.57	188.5	8.7
8D*	67.8	50	82.0	2.12	207.2	21.1
9D	188.8	250	125.7	1.69	168.0	14.0
10D	276.3	500	122.0	0.83	185.7	8.8
11D*	141.6	100	96.5	1.83	159.9	10.7
12D	268.4	185	74.3	2.15	91.5	10.6
13D	1132.5	800	75.7	1.05	33.0	6.2
14D	938.2	555	88.9	1.37	50.0	7.8
15D*	185.5	125	118.1	1.78	115.4	14.1
16D	1145.4	775	60.8	1.43	141.0	7.1
17D	1689.2	900	61.8	1.38	144.9	11.4
18D*	864.6	700	87.5	1.04	216.6	9.7
19D	1180.0	850	61.0	3.38	66.0	9.2
20D	1817.1	1200	34.5	0.69	33.0	8.5
21D	1648.3	1000	68.0	1.82	113.3	8.9
22D	1883.0	1200	68.1	1.78	85.6	11.3

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
23D	1295.8	850	80.6	1.83	92.8	12.0
24D*	2347.2	1500	35.5	2.00	69.4	5.9
25D	2702.4	1800	45.7	3.50	77.6	8.2
26D	1216.7	800	107.3	1.95	92.6	10.9
27D	1776.6	1340	127.5	9.77	240.1	18.9
28D	482.3	365	170.5	7.08	216.4	21.4
29D	832.4	1115	348.6	4.84	229.4	14.3
30D*	635.9	450	79.4	7.24	85.8	9.1
31D	764.5	550	110.7	5.13	129.5	14.6
32D	748.8	525	61.9	5.04	106.8	11.0
33D	1564.9	1195	61.4	2.53	70.2	5.8
34D	252.4	245	90.1	3.42	87.9	7.3
35D	246.0	175	82.1	3.59	81.6	9.6
36D	207.0	180	75.0	3.00	111.1	13.4
37D	3158.6	2135	40.1	2.11	46.0	5.4
38D	647.2	450	33.0	2.13	55.7	5.9
39D	564.8	300	47.5	3.64	68.0	7.3
40D	649.5	450	85.4	2.87	84.8	8.0
41D	5837.3	3570	44.1	2.25	40.1	5.7
42D	1556.3	980	49.2	2.12	71.9	6.7
43D	2098.0	1350	38.8	2.28	54.2	5.6
44D	5351.1	3455	59.9	2.54	56.9	5.8

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
45D	1361.6	1025	73.9	2.16	79.0	14.4
46D	2743.8	1770	49.0	2.20	54.0	7.4
47D	2490.8	1900	106.1	5.80	122.6	18.4
48D	546.5	418	114.8	7.15	171.7	19.6
49D	1196.2	1200	198.6	8.05	249.0	13.8
50D	303.5	280	141.8	7.30	239.6	24.8
51D	5992.6	4050	67.6	4.95	106.6	17.7
52D	1229.8	880	62.0	4.73	127.1	17.0
53D	3140.9	1675	63.2	4.89	89.2	10.8
54D	1248.9	810	63.3	4.86	104.0	17.6
55D	1424.8	970	60.5	4.47	103.2	16.6
56D	1686.9	1125	115.0	3.88	74.6	8.9
57D	731.2	515	202.9	4.16	92.0	10.8
58D	465.3	350	58.4	5.45	88.2	12.3
59D	1584.1	1485	77.0	6.17	75.4	10.1
60D	497.6	350	61.1	7.29	119.9	15.1
61D	5006.8	3100	41.2	3.14	73.7	11.7
62D	1031.3	800	74.8	1.67	69.4	10.3
63D	189.4	100	51.4	2.69	58.0	11.1
64D	277.5	200	97.1	3.03	84.4	8.5
65D	237.4	200	71.9	3.04	77.0	11.9
66D	484.2	400	83.0	5.14	99.9	15.8

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
67D	17108.9	11250	43.3	1.76	44.2	5.6
68D	1066.9	700	51.8	2.26	62.6	9.6
69D	809.6	550	37.0	2.58	63.0	9.3
70D	808.8	550	46.3	3.10	78.9	8.9
71D	921.6	600	42.8	1.92	56.3	6.4
72D	1084.4	700	65.9	2.30	60.1	8.8
73D	3348.2	2150	32.9	1.48	35.9	5.8
74D	2387.8	1650	46.0	2.10	49.4	6.1
75D	2463.4	1625	38.9	1.76	53.5	5.9
76D	2191.9	1500	44.1	1.15	50.7	6.8
77D	2849.3	1700	36.1	1.32	60.0	6.9
78D	4625.7	3155	38.5	4.94	67.5	11.3
79D	502.8	355	43.2	2.92	95.3	10.4
80D	2120.7	1350	38.0	2.17	77.1	11.4
81D*	3799.4	2600	33.7	3.13	87.4	12.2
82D	1546.7	1350	93.4	2.84	126.4	14.8
83D	412.5	350	69.9	2.78	115.8	18.5
84D	17598.1	11900	24.9	1.17	45.6	8.7
85D	758.2	450	42.6	2.63	88.6	12.2
86D	1152.8	800	50.9	2.11	73.1	15.9
87D*	2979.6	2050	52.0	4.00	65.7	9.1
88D	1134.2	800	77.6	1.74	132.5	17.1

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
89D	494.7	400	59.1	1.58	111.8	16.2
90D	13088.3	7495	40.7	1.39	44.7	7.1
91D*	3205.6	1905	52.6	1.37	79.6	13.4
92D	1487.6	1000	46.3	1.70	78.9	11.9
93D	1554.7	1025	49.3	3.21	87.4	6.1
94D	1418.6	1000	53.8	1.78	83.3	12.0
95D	9013.4	7200	111.3	1.03	60.1	8.0
96D	399.8	350	58.2	2.14	96.5	11.6
97D	159.6	125	105.0	5.63	99.1	19.5
98D	241.8	100	87.2	3.70	93.3	16.1
99D	1581.7	1080	54.9	2.43	56.1	7.3
100D	404.7	300	45.7	2.24	72.7	8.3
101D	446.5	380	55.0	3.08	70.1	8.1
102D	2135.5	1600	34.2	1.78	51.5	6.9
103D	1103.4	800	36.1	2.00	67.3	8.5
104D	774.1	580	43.2	2.18	66.3	7.2
105D	2378.7	1600	27.8	1.57	59.1	6.9
106D	1629.1	1000	35.0	1.54	46.3	6.2
107D	1382.8	1000	39.3	1.65	62.9	6.9
108D	2826.7	2000	46.7	1.72	68.0	7.3
109D	7884.5	6030	51.1	3.71	111.1	9.9
110D	1320.1	1000	41.1	2.18	79.1	8.1

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT (G)	DRY VOLUME (ML)	VOLATILE SOLIDS (MG/G)	BOD (MG/G)	COD (MG/G)	GREASE (MG/G)
111D	1414.8	1100	51.2	5.54	78.7	9.8
112D	2032.8	1300	44.3	1.01	75.4	8.2
113D	427.4	250	59.6	2.78	99.8	11.0
114D	522.3	380	55.2	1.65	81.4	5.4
115D	287.6	220	62.7	3.79	83.1	11.3
116D	1403.2	1000	35.8	2.12	61.6	9.2
117D	1873.4	1350	58.0	2.80	85.9	11.8
118D	689.3	400	54.0	2.98	114.6	14.4
119D	4528.7	3100	26.0	1.45	56.1	5.8
120D	1108.6	800	52.0	1.28	87.1	12.0
121D	1229.1	800	48.5	2.27	79.0	8.2
122D	1319.8	900	50.1	1.66	91.1	10.2
123D	690.2	500	55.6	2.51	80.2	9.4
124D	351.5	180	43.9	1.91	78.6	10.1
125D	834.7	600	46.8	1.54	73.0	10.2
126D	1574.2	950	66.2	3.36	134.5	14.2
127D	1138.8	900	59.9	1.79	80.2	9.4

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
1D	0.207	0.008	7.2	1.48	1.44	0.06
2D	0.395	0.022	3.8	8.05	2.69	0.16
3D	0.215	0.018	8.0	11.41	3.00	0.12
4D	0.127	0.019	9.8	4.16	1.81	0.12
5D	0.222	0.005	26.8	8.19	3.72	0.12
6D	0.171	0.031	13.6	19.80	3.06	0.14
7D	0.403	0.006	11.9	0.01	1.60	0.22
8D*	0.464	0.001	7.9	0.02	1.47	0.35
9D	0.390	0.001	3.6	0.42	0.47	0.33
10D	0.444	0.005	7.3	0.16	1.94	0.21
11D*	0.220	0.001	1.7	4.69	1.02	0.33
12D	0.298	0.006	4.9	3.60	0.82	0.25
13D	0.163	0.000	4.5	0.01	0.38	0.12
14D	0.395	0.002	2.6	0.01	0.23	0.10
15D*	0.268	0.000	6.6	0.14	0.95	0.16
16D	0.386	0.001	1.7	0.79	0.45	0.21
17D	0.224	0.002	5.7	0.07	0.47	0.19
18D*	0.556	0.001	2.6	0.32	0.45	0.29
19D	0.215	0.001	1.9	0.07	0.29	0.21
20D	0.220	0.000	5.3	0.03	0.38	0.14
21D	0.532	0.000	33.4	0.59	0.49	0.09
22D	0.395	0.083	24.8	1.40	0.42	0.35

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
23D	0.298	0.081	33.1	1.54	0.34	0.28
24D*	0.249	0.007	23.8	2.55	0.27	0.17
25D	0.366	0.008	28.9	2.85	0.29	0.29
26D	0.273	0.000	17.9	3.29	0.49	0.22
27D	0.212	0.001	12.2	0.02	0.25	0.28
28D	0.201	0.008	28.0	0.01	1.06	0.29
29D	0.231	0.020	17.3	0.01	1.79	0.21
30D*	---	---	----	----	0.25	0.12
31D	0.149	0.023	30.4	0.03	0.24	0.21
32D	0.159	0.042	23.1	0.01	0.23	0.37
33D	0.305	0.029	20.8	0.03	0.41	0.32
34D	0.226	0.133	42.9	0.01	0.31	0.26
35D	0.393	0.005	14.8	0.03	0.39	0.44
36D	0.256	0.001	19.5	0.05	1.00	0.25
37D	0.220	0.021	15.2	0.01	0.08	0.35
38D	0.256	0.063	35.5	0.04	0.09	0.27
39D	0.002	0.001	9.7	0.07	0.35	0.42
40D	0.002	0.000	13.4	0.11	0.32	0.26
41D	0.226	0.000	----	0.08	0.42	1.42
42D	0.371	0.000	21.3	0.03	0.44	1.15
43D	0.244	0.000	21.0	0.03	0.29	1.26
44D	0.229	0.000	14.9	0.18	0.20	0.54

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
45D	0.354	0.000	12.8	0.06	0.23	0.26
46D	0.215	0.000	16.1	0.13	0.20	1.37
47D	0.146	0.021	21.3	0.02	1.33	0.23
48D	0.149	0.032	28.6	0.03	1.04	0.20
49D	0.110	0.051	35.3	0.08	1.09	0.33
50D	0.161	0.017	28.0	0.19	0.75	0.23
51D	0.160	0.009	15.2	0.04	0.58	0.41
52D	0.159	0.000	14.7	0.46	0.51	0.24
53D	0.146	0.003	10.6	0.02	0.63	0.16
54D	0.207	0.013	19.5	0.01	0.46	0.21
55D	0.161	0.000	17.9	0.04	0.47	0.18
56D	0.165	0.014	14.9	0.00	0.35	0.48
57D	0.266	0.021	13.5	0.00	0.12	0.40
58D	0.250	0.014	13.4	0.01	0.18	0.27
59D	0.181	0.021	10.9	0.00	0.20	0.41
60D	0.173	0.041	15.2	0.00	0.52	0.49
61D	0.268	0.000	12.5	0.15	0.74	0.21
62D	0.207	0.000	28.9	0.04	0.59	0.31
63D	0.281	0.000	22.2	0.23	0.66	4.93
64D	0.275	0.000	24.9	0.06	0.65	3.36
65D	0.295	0.002	25.2	0.12	0.29	2.32
66D	0.348	0.011	17.9	0.23	0.16	4.15

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
67D	0.207	0.000	4.4	0.02	0.51	0.14
68D	0.229	0.000	23.6	0.30	0.44	0.41
69D	0.238	0.000	11.4	0.28	0.36	0.72
70D	0.220	0.000	10.3	0.22	0.35	1.63
71D	0.232	0.000	9.0	0.13	0.33	0.80
72D	0.226	0.000	20.7	0.32	0.26	1.14
73D	0.266	0.000	8.5	0.48	0.05	0.63
74D	0.311	0.000	20.1	0.23	0.04	0.46
75D	0.241	0.000	13.7	0.15	0.06	0.53
76D	0.256	0.000	14.1	0.11	0.13	0.50
77D	0.248	0.001	27.7	0.03	0.17	0.66
78D	0.117	0.001	25.5	0.03	0.25	0.19
79D	0.231	0.002	28.0	0.07	0.39	0.30
80D	0.146	0.006	14.6	0.00	0.28	0.63
81D*	---	---	----	----	----	0.10
82D	0.205	0.010	12.2	0.03	0.26	0.45
83D	0.168	0.005	17.6	0.04	0.74	0.31
84D	0.116	0.010	9.4	0.01	0.18	0.18
85D	0.199	0.001	23.1	0.05	0.39	0.28
86D	0.214	0.031	20.1	0.01	0.47	0.44
87D*	---	---	----	----	----	0.14
88D	0.268	0.011	11.5	0.03	0.43	0.45

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
89D	0.165	0.007	12.8	0.03	0.52	0.33
90D	0.134	0.001	16.3	0.02	0.29	0.06
91D*	0.178	0.005	23.4	0.02	0.33	0.23
92D	0.183	0.007	11.6	0.02	0.39	0.23
93D	0.159	0.000	21.6	0.01	0.43	0.28
94D	0.214	0.020	26.8	0.01	0.41	0.29
95D	0.313	0.000	3.3	0.09	0.36	0.82
96D	0.360	0.000	13.7	0.35	0.55	0.45
97D	0.421	0.000	18.5	0.13	0.02	1.09
98D	0.583	0.001	20.7	0.15	0.02	0.85
99D	0.262	0.000	18.2	0.02	0.45	0.13
100D	0.219	0.000	24.0	0.03	0.68	0.25
101D	0.323	0.063	41.3	0.00	0.81	0.27
102D	0.217	0.000	11.6	0.03	0.33	0.16
103D	0.197	0.000	62.0	0.09	0.43	0.16
104D	0.287	0.011	75.4	0.00	0.79	0.32
105D	0.226	0.000	17.0	0.03	0.23	0.30
106D	0.280	0.000	25.0	0.02	0.27	0.48
107D	0.281	0.046	36.5	0.01	0.27	0.54
108D	0.311	0.047	14.7	0.08	0.27	0.44
109D	0.315	0.095	20.1	0.00	0.68	0.25
110D	0.229	0.056	21.9	0.00	0.45	0.12

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 2

SAMP. NO.	TOTAL PO4-P (MG/G)	PO4-P (MG/G)	NO3-N (UG/G)	NO2-N (UG/G)	KJELD. N (MG/G)	CL (MG/G)
111D	0.268	0.092	23.1	0.00	0.34	0.25
112D	0.201	0.000	9.7	0.01	0.43	0.18
113D	0.244	0.001	17.3	0.01	0.91	0.56
114D	0.256	0.019	30.4	0.02	0.79	0.66
115D	0.190	0.001	20.6	0.01	0.23	0.45
116D	0.207	0.041	26.8	0.00	0.55	0.13
117D	0.336	0.049	34.7	0.00	1.28	0.10
118D	0.232	0.055	24.9	0.01	0.47	0.36
119D	0.116	0.015	17.3	0.02	0.33	0.09
120D	0.110	0.019	35.2	0.00	0.55	0.26
121D	0.092	0.011	22.9	0.01	0.57	0.11
122D	0.110	0.021	27.3	0.00	0.51	0.15
123D	0.173	0.058	19.8	0.01	0.55	0.31
124D	0.214	0.000	19.5	0.01	0.47	0.19
125D	0.390	0.000	21.3	0.01	0.52	0.26
126D	0.390	0.067	11.6	0.02	0.93	0.24
127D	0.342	0.047	23.1	0.01	0.50	0.21

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 3

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
1D	0.4	0.0	0.0	---	0	0	0.00	0.00
2D	0.2	0.0	1.3	---	0	0	0.00	0.00
3D	0.7	0.0	0.0	---	0	0	0.00	0.00
4D	5.7	4.5	1.1	---	0	0	0.00	0.00
5D	2.0	1.8	1.3	---	0	0	0.00	0.00
6D	7.0	4.9	0.5	---	---	---	0.00	0.00
7D	6.0	3.6	0.0	---	0	0	0.00	0.00
8D*	11.3	8.7	---	---	40000	0	0.00	0.00
9D	6.6	5.7	0.3	---	40000	0	0.00	0.00
10D	4.3	3.5	0.0	---	13700	0	0.00	0.00
11D*	6.0	5.0	---	---	300000	0	0.00	0.00
12D	4.2	3.8	0.0	6.4	1050	0	0.00	0.00
13D	2.1	1.7	0.3	5.2	0	0	0.00	0.00
14D	3.3	2.9	0.7	---	0	0	0.00	0.00
15D*	7.3	5.0	---	---	100	0	0.00	0.00
16D	3.2	3.0	0.0	---	350	0	0.00	0.00
17D	3.0	2.6	0.1	4.0	0	0	0.00	0.00
18D*	4.3	4.0	---	---	0	0	0.00	0.00
19D	4.1	3.7	0.4	10.8	0	0	0.00	0.00
20D	3.1	2.8	0.0	---	150	250	0.00	0.00
21D	4.9	4.1	0.7	---	0	0	0.00	0.00
22D	5.2	4.1	0.4	---	250	0	0.00	0.00

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
23D	5.7	4.2	0.9	---	0	350	0.00	0.00
24D*	3.7	2.8	---	10.0	0	0	0.00	0.00
25D	3.7	2.6	0.8	8.0	0	0	0.00	0.00
26D	5.8	4.7	0.5	8.8	0	0	0.00	0.00
27D	6.2	4.9	0.0	---	0	550	0.00	0.00
28D	7.1	5.8	0.0	---	0	850	0.00	0.00
29D	5.2	4.1	0.6	---	0	450	0.00	--
30D*	8.8	7.5	0.1	---	0	1650	0.00	--
31D	5.9	5.1	0.0	3.4	0	650	0.00	--
32D	5.3	2.9	0.1	7.7	0	2400	0.00	--
33D	3.1	2.2	0.3	---	12200	605	--	--
34D	4.2	3.9	0.8	---	26600	7605	--	--
35D	6.3	5.0	0.3	2.8	10	735	--	--
36D	10.9	5.4	0.8	2.4	10	155	--	--
37D	2.7	2.2	0.5	---	0	5275	0.00	--
38D	3.7	3.1	0.5	---	0	90	0.00	--
39D	4.6	3.9	0.3	6.8	0	95	--	--
40D	4.6	3.9	0.3	5.2	0	20	--	--
41D	3.8	2.2	5.1	---	0	3100	--	--
42D	4.0	3.6	2.6	---	0	5200	--	--
43D	3.0	2.3	7.6	4.0	0	1180	--	--
44D	2.7	2.4	6.4	4.8	0	5000	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 3

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
45D	6.7	1.7	5.1	---	0	2280	0.00	--
46D	3.6	2.4	7.0	---	250	1625	--	--
47D	6.5	6.1	4.5	---	0	2800	--	--
48D	7.1	0.6	2.5	8.3	0	950	0.00	--
49D	6.0	4.2	1.9	6.4	0	650	0.00	--
50D	8.5	6.1	3.8	---	0	700	--	--
51D	7.5	3.7	1.9	---	0	625	0.00	--
52D	8.3	6.6	1.9	---	0	50	--	--
53D	2.3	1.1	2.5	1.2	0	275	--	--
54D	7.6	5.3	0.5	---	0	275	--	--
55D	7.8	7.2	1.3	4.3	1200	100	--	--
56D	4.8	3.9	2.6	---	0	250	--	--
57D	6.0	4.6	1.3	4.8	0	200	--	--
58D	7.9	5.6	3.8	---	0	700	0.00	--
59D	5.0	3.4	1.3	---	0	1100	--	--
60D	8.4	6.8	3.8	9.8	0	500	--	--
61D	7.5	6.0	0.6	---	0	200	--	--
62D	6.8	3.1	1.3	4.8	0	2825	--	--
63D	8.3	7.3	0.0	---	0	25	--	--
64D	7.8	5.7	2.6	---	0	3100	--	--
65D	9.1	6.3	3.8	---	0	125	0.00	--
66D	9.5	9.3	1.3	6.8	0	550	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 3

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
67D	3.5	1.8	0.0	---	0	100	--	--
68D	6.0	4.6	0.0	2.5	0	50	--	--
69D	5.4	4.4	2.6	---	0	75	--	--
70D	4.5	4.0	0.0	---	0	25	0.00	--
71D	4.4	3.0	0.0	---	0	300	--	--
72D	6.4	5.5	1.3	3.6	0	0	--	--
73D	3.7	3.4	5.1	---	0	125	--	--
74D	2.9	2.1	2.6	3.4	0	25	--	--
75D	4.4	4.0	1.3	3.8	0	0	--	--
76D	4.7	3.2	2.6	1.6	0	0	--	--
77D	4.2	3.7	0.0	---	0	25	--	--
78D	8.3	5.0	1.3	---	0	1975	--	--
79D	6.5	5.1	3.8	6.0	0	575	--	--
80D	7.0	6.6	2.6	---	0	0	--	--
81D*	7.5	7.1	---	---	---	---	0.00	--
82D	8.7	6.9	3.8	6.2	0	0	--	--
83D	12.4	9.5	1.3	---	0	50	--	--
84D	4.5	3.7	0.6	---	0	275	--	--
85D	6.8	5.5	3.8	4.0	0	175	--	--
86D	9.0	6.9	0.0	---	0	0	--	--
87D*	6.0	4.5	---	---	---	---	0.00	--
88D	9.7	7.0	0.6	9.2	0	0	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 3

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
89D	10.0	8.0	0.0	---	0	25	--	--
90D	4.8	3.0	2.6	---	0	50	--	--
91D*	7.1	6.6	1.3	4.5	0	0	--	--
92D	6.7	5.2	1.3	---	0	75	0.00	--
93D	5.1	4.3	1.3	---	0	0	--	--
94D	4.6	3.7	1.3	3.1	0	0	--	--
95D	3.6	3.5	5.1	---	0	25	--	--
96D	5.8	5.0	1.3	2.1	50	0	--	--
97D	12.1	10.3	2.6	---	0	0	--	--
98D	9.2	6.5	1.3	5.8	0	0	--	--
99D	5.4	4.4	2.6	---	0	1525	--	--
100D	5.4	4.5	1.3	1.0	0	25	--	--
101D	5.1	4.3	1.3	3.1	600	0	--	--
102D	5.4	3.0	2.6	---	0	0	--	--
103D	6.3	4.7	1.3	2.0	0	0	--	--
104D	3.9	3.7	1.3	1.9	0	100	--	--
105D	3.6	3.9	2.6	---	0	0	--	--
106D	4.0	3.7	1.3	1.7	0	0	--	--
107D	4.4	3.8	0.0	---	0	50	--	--
108D	4.2	1.1	1.3	1.8	0	0	--	--
109D	5.6	4.2	1.3	---	100	2500	--	--
110D	5.9	3.4	0.0	0.5	0	450	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 3

SAMP. NO.	PETRO. (MG/G)	N-PAR. (MG/G)	ASBESTOS (FBRS/G) X10EXP-5	RUBBER (MG/G)	FECAL COLIF. (ORG/G)	FECAL STREP (ORG/G)	CN (MG/G)	CR+6 (MG/G)
111D	4.7	3.9	1.3	2.7	0	700	--	--
112D	5.0	4.5	3.8	---	0	0	--	--
113D	6.3	5.6	5.1	---	0	25	--	--
114D	5.3	4.6	7.7	4.2	0	0	--	--
115D	6.4	5.4	0.0	4.1	0	350	--	--
116D	4.4	4.0	---	1.3	0	875	--	--
117D	5.5	5.5	---	---	0	50	--	--
118D	7.9	6.5	---	---	0	450	--	--
119D	4.1	2.7	---	---	0	0	--	--
120D	6.6	4.7	---	---	0	600	--	--
121D	5.0	4.7	---	---	0	0	--	--
122D	5.6	5.4	---	---	0	0	--	--
123D	5.2	2.7	---	---	250	1950	--	--
124D	6.4	5.2	---	---	925	825	--	--
125D	5.9	4.5	---	---	100	5700	--	--
126D	7.1	6.4	---	---	14275	103500	--	--
127D	4.7	3.6	---	---	1575	39100	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

SAMP. NO.	METAL CONTENT (UG/G) PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
1D	815	39	90	67	---	--	---	0.00	--	--	--	--	--
2D	467	35	300	198	---	9.68	.160	0.00	6	30	40	0	0
3D	265	33	199	157	---	--	---	0.00	--	--	--	--	--
4D	158	39	426	306	---	--	---	0.00	--	--	--	--	--
5D	448	50	332	210	---	--	---	0.00	--	--	--	--	--
6D	171	52	437	281	---	--	---	0.10	--	--	--	--	--
7D	3020	38	153	125	1790	--	---	0.00	--	--	--	--	--
8D*	----	---	---	---	---	--	---	--	--	--	--	--	--
9D	3840	49	589	389	7680	--	---	0.00	--	--	--	--	--
10D	2230	30	205	425	5460	0.00	100	0.00	10	40	30	0	0
11D*	----	---	---	---	---	--	---	--	--	--	--	--	--
12D	3870	27	124	300	4440	--	---	0.00	--	--	--	--	--
13D	3640	27	106	97	1730	--	---	0.10	--	--	--	--	--
14D	4040	29	61	63	1480	--	---	0.00	--	--	--	--	--
15D*	----	---	---	---	---	--	---	--	--	--	--	--	--
16D	4560	30	657	185	1940	--	---	0.00	--	--	--	--	--
17D	5940	21	161	40	2110	--	---	0.00	--	--	--	--	--
18D*	----	---	---	---	---	--	---	--	--	--	--	--	--
19D	5350	21	78	63	898	3.82	110	0.00	6	30	30	0	0
20D	3950	28	115	62	1170	--	---	0.00	--	--	--	--	--
21D	22200	45	1250	118	2420	--	---	0.00	--	--	--	--	--
22D	17100	46	125	133	2810	--	---	0.00	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

SAMP. NO.	METAL CONTENT (UG/G) PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
23D	14300	34	116	130	2720	--	---	0.00	--	--	--	--	--
24D*	----	---	---	---	---	--	---	--	--	--	--	--	--
25D	16000	37	139	275	1640	--	---	0.00	--	--	--	--	--
26D	14700	29	126	107	2420	6.91	100	0.00	7	70	60	0	0
27D	3420	167	52	123	1210	--	---	0.00	--	--	--	--	--
28D	3870	228	66	137	3040	3.87	60	0.00	6	50	40	0	0
29D	1920	83	51	89	1170	--	---	0.00	--	--	--	--	--
30D*	----	---	---	---	---	--	---	--	--	--	--	--	--
31D	3810	129	50	133	1200	--	---	0.00	--	--	--	--	--
32D	2740	169	46	139	751	--	---	0.00	--	--	--	--	--
33D	6650	22	92	31	665	--	98	--	--	--	--	--	--
34D	6740	23	58	38	3430	3.12	38	0.08	2	37	0	0	0
35D	3620	51	81	49	796	--	0	--	--	--	--	--	--
36D	2782	94	57	101	1073	2.00	---	--	--	--	--	--	--
37D	10400	32	116	65	1120	--	138	--	--	--	--	--	--
38D	6800	27	1320	56	1070	7.20	97	0.06	37	0	0	0	16
39D	8930	31	74	58	1280	--	78	--	--	--	--	--	--
40D	3523	78	148	239	1529	3.00	---	--	--	--	--	--	--
41D	7677	203	362	239	879	6.00	---	--	--	--	--	--	--
42D	23900	39	118	89	1680	--	135	--	--	--	--	--	--
43D	9860	25	165	70	1180	278.00	57	0.00	4	0	0	0	0
44D	12300	33	198	115	1110	--	115	--	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

SAMP. NO.	PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
				METAL CONTENT (UG/G)									
45D	11900	39	72	120	936	--	68	--	--	--	--	--	--
46D	14000	36	92	106	1070	--	96	--	--	--	--	--	--
47D	1930	76	37	82	409	--	0	--	--	--	--	--	--
48D	2230	151	71	136	1280	--	77	--	--	--	--	--	--
49D	3890	85	117	101	837	1.66	52	0.16	2	0	0	0	0
50D	2154	133	45	98	1530	--	59	--	--	--	--	--	--
51D	899	14	100	55	528	--	18	--	--	--	--	--	--
52D	1560	18	80	88	840	--	0	--	--	--	--	--	--
53D	1100	9	45	93	450	0.69	52	0.00	0	0	0	0	0
54D	994	15.	65	109	490	--	0	--	--	--	--	--	--
55D	641	6	12	41	237	--	0	--	--	--	--	--	--
56D	898	18	37	61	368	--	0	--	--	--	--	--	--
57D	3260	15	59	79	2130	1.36	0	0.05	0	0	0	0	0
58D	3410	18	2960	115	2800	--	72	--	--	--	--	--	--
59D	2090	12	23	27	753	--	0	--	--	--	--	--	--
60D	1190	53	89	301	2910	4.00	---	--	--	--	--	--	--
61D	2206	130	46	95	647	5	---	--	--	--	--	--	--
62D	1510	87	68	247	1020	4	---	--	--	--	--	--	--
63D	4927	83	61	78	541	3	---	--	--	--	--	--	--
64D	1960	162	57	153	971	4	---	--	--	--	--	--	--
65D	2865	83	54	103	1116	6	---	--	--	--	--	--	--
66D	1020	73	42	131	1160	3	---	--	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

SAMP. NO.	PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
				METAL CONTENT (UG/G)									
67D	2578	88	72	74	394	3	---	--	--	--	--	--	--
68D	2160	141	67	287	2030	4	---	--	--	--	--	--	--
69D	2206	170	85	121	640	2	---	--	--	--	--	--	--
70D	2070	130	51	123	721	2	---	--	--	--	--	--	--
71D	2005	88	94	89	554	3	---	--	--	--	--	--	--
72D	1460	71	65	127	476	2	---	--	--	--	--	--	--
73D	7980	205	73	199	554	3	---	--	--	--	--	--	--
74D	3065	160	34	189	288	2	---	--	--	--	--	--	--
75D	3350	122	49	162	358	2	---	--	--	--	--	--	--
76D	6911	181	42	179	428	2	---	--	--	--	--	--	--
77D	3080	191	51	213	434	2	---	--	--	--	--	--	--
78D	1150	66	16	77	186	1	---	--	--	--	--	--	--
79D	1400	82	115	172	857	2	---	--	--	--	--	--	--
80D	1240	75	34	80	633	1	---	--	--	--	--	--	--
81D*	----	---	---	---	---	--	---	--	--	--	--	--	--
82D	1370	73	27	78	638	1	---	--	--	--	--	--	--
83D	1470	57	46	85	1570	2	---	--	--	--	--	--	--
84D	2630	102	26	78	206	2	---	--	--	--	--	--	--
85D	2610	84	41	117	930	2	---	--	--	--	--	--	--
86D	2370	84	38	142	473	1	---	--	--	--	--	--	--
87D*	----	---	---	---	---	--	---	--	--	--	--	--	--
88D	2430	84	30	96	899	1	---	--	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

SAMP. NO.	PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
	METAL CONTENT (UG/G)												
89D	2680	78	50	76	1640	1	---	--	--	--	--	--	--
90D	485	89	25	108	204	4	---	--	--	--	--	--	--
91D*	----	---	---	---	---	--	---	--	--	--	--	--	--
92D	879	113	49	173	349	0	---	--	--	--	--	--	--
93D	1190	85	39	86	335	1	---	--	--	--	--	--	--
94D	659	121	69	129	214	0	---	--	--	--	--	--	--
95D	3890	61	54	69	325	2	---	--	--	--	--	--	--
96D	4150	90	59	74	730	4	---	--	--	--	--	--	--
97D	3990	54	33	66	375	3	---	--	--	--	--	--	--
98D	3990	79	69	84	754	3	---	--	--	--	--	--	--
99D	2390	89	54	101	445	2	---	--	--	--	--	--	--
100D	1760	172	56	143	701	3	---	--	--	--	--	--	--
101D	1330	203	185	12	478	3	---	--	--	--	--	--	--
102D	2680	83	46	93	550	2	---	--	--	--	--	--	--
103D	8140	84	---	91	580	3	---	--	--	--	--	--	--
104D	3160	73	---	89	478	2	---	--	--	--	--	--	--
105D	10500	139	37	157	640	3	---	--	--	--	--	--	--
106D	10200	160	51	160	506	2	---	--	--	--	--	--	--
107D	5580	128	48	117	534	2	---	--	--	--	--	--	--
108D	6270	109	42	241	2420	3	---	--	--	--	--	--	--
109D	2520	55	29	41	337	1	---	--	--	--	--	--	--
110D	1660	82	46	67	464	4	---	--	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 4

METAL CONTENT (UG/G)

SAMP. NO.	PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
111D	2110	90	49	76	397	4	---	--	--	--	--	--	--
112D	12400	77	40	76	593	2	---	--	--	--	--	--	--
113D	7440	77	54	94	1270	4	---	--	--	--	--	--	--
114D	4590	126	36	71	908	5	---	--	--	--	--	--	--
115D	8910	104	97	134	761	18	---	--	--	--	--	--	--
116D	907	117	58	87	123	3	---	--	--	--	--	--	--
117D	1210	90	72	81	611	6	---	--	--	--	--	--	--
118D	2150	173	47	80	690	1	---	--	--	--	--	--	--
119D	2185	85	62	82	373	1	---	--	--	--	--	--	--
120D	3415	104	67	111	1050	2	---	--	--	--	--	--	--
121D	2068	91	213	94	923	2	---	--	--	--	--	--	--
122D	1929	103	41	111	842	1	---	--	--	--	--	--	--
123D	2943	75	37	69	495	1	---	--	--	--	--	--	--
124D	4621	63	61	87	902	2	---	--	--	--	--	--	--
125D	2442	55	51	62	490	1	---	--	--	--	--	--	--
126D	3365	56	45	69	785	3	---	--	--	--	--	--	--
127D	2542	56	44	65	951	4	---	--	--	--	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-2 (CONTINUED). ANALYSES OF DUST AND DIRT - PART 5

Sample No.	PCB's (ppm)	Chlor. Pesticides (ppm)
4D	3.6	<0.01
25D	0.6	<0.01
31D	0.5	<0.01
39D	4.7	<0.01
45D	1.2	<0.01
59D	1.2	<0.01
64D	1.8	<0.01
72D	2.7	<0.01
85D	1.8	<0.01
86D	0.9	0.01 DDT
93D	1.0	<0.01
98D	1.3	<0.01

TABLE B-3. ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
1F	--	----	----	----	--	---	---
2F	--	----	----	----	--	---	---
3F	--	----	----	----	--	---	---
4F	--	----	----	----	--	---	---
5F	--	----	----	----	--	---	---
6F	--	----	----	----	--	---	---
7F	9	1574	311	1499	37	708	59.8
8F*	14	430	43	332	32	230	20.2
9F	15	426	159	340	34	214	20.8
10F	8	444	334	434	37	238	19.0
11F*	10	274	234	244	23	192	21.7
12F	15	454	289	380	33	307	28.0
13F	18	509	274	425	40	260	30.6
14F	--	----	----	----	--	---	---
15F*	--	----	----	----	--	---	---
16F	--	----	----	----	--	---	---
17F	--	----	----	----	--	---	---
18F*	--	----	----	----	--	---	---
19F	--	----	----	----	--	---	---
20F	--	----	----	----	--	---	---
21F	14	2074	411	1769	23	234	69.4
22F	8	1134	297	1095	28	424	48.2

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
23F	10	950	277	657	24	431	31.8
24F*	26	532	83	379	16	257	21.2
25F	8	790	281	501	34	424	29.8
26F	13	1126	405	785	50	522	31.8
27F	--	----	----	----	--	---	---
28F	--	----	----	----	--	---	---
29F	--	----	----	----	--	---	---
30F*	--	----	----	----	--	---	---
31F	--	----	----	----	--	---	---
32F	--	----	----	----	--	---	---
33F	10	713	241	340	30	173	24.8
34F	10	438	266	460	29	199	36.2
35F	5	3	426	390	26	85	24.0
36F	10	58	341	455	27	151	26.8
37F	--	----	----	----	--	---	---
38F	--	----	----	----	--	---	---
39F	--	----	----	----	--	---	---
40F	--	----	----	----	--	---	---
41F	--	----	----	----	--	---	---
42F	8	3043	1206	1835	31	479	57.4
43F	10	1723	986	1605	25	401	37.4
44F	10	2273	816	1220	30	323	50.8

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
45F	17	3193	946	565	29	348	69.8
46F	22	653	566	485	27	239	27.0
47F	--	----	----	----	--	---	---
48F	--	----	----	----	--	---	---
49F	--	----	----	----	--	---	---
50F	--	----	----	----	--	---	---
51F	40	1153	501	1250	52	324	65.4
52F	35	1048	446	980	45	265	51.4
53F	30	663	376	820	43	234	37.0
54F	35	1018	316	1035	52	309	46.6
55F	25	768	306	525	55	260	47.2
56F	33	843	151	995	28	229	45.6
57F	15	908	116	380	29	188	32.2
58F	12	428	116	500	34	215	34.2
59F	18	713	191	730	59	255	39.2
60F	14	438	121	450	47	178	23.8
61F	--	----	----	----	--	---	---
62F	--	----	----	----	--	---	---
63F	--	----	----	----	--	---	---
64F	--	----	----	----	--	---	---
65F	--	----	----	----	--	---	---
66F	--	----	----	----	--	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
67F	--	----	----	----	--	---	---
68F	--	----	----	----	--	---	---
69F	--	----	----	----	--	---	---
70F	--	----	----	----	--	---	---
71F	--	----	----	----	--	---	---
72F	--	----	----	----	--	---	---
73F	20	1558	146	1585	14	256	4.0
74F	14	2188	271	1825	20	295	4.3
75F	15	853	40	1000	20	270	2.4
76F	2	2098	1631	1120	14	225	2.6
77F	10	1418	236	1350	15	281	4.5
78F	25	3098	461	2550	36	209	47.0
79F	36	1743	206	1680	24	276	70.0
80F	15	1483	236	1265	52	497	72.0
81F*	--	----	----	----	--	---	---
82F	20	1493	211	1535	52	225	83.4
83F	28	1453	136	1585	32	252	158.2
84F	5	5333	836	3690	39	334	138.0
85F	28	1503	111	750	10	268	40.0
86F	2	4893	536	3915	49	556	158.0
87F*	--	----	----	----	--	---	---
88F	10	1398	201	1570	48	215	48.0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
89F	8	623	121	420	12	155	59.4
90F	67	3453	371	3565	14	366	70.0
91F*	30	3088	261	1965	11	161	53.8
92F	15	558	111	690	12	101	31.4
93F	18	758	141	880	15	197	40.4
94F	20	653	121	700	13	164	27.6
95F	18	5843	956	5460	24	162	160.8
96F	25	933	146	900	18	132	36.8
97F	35	843	96	910	24	101	27.2
98F	12	363	40	510	19	55	16.6
99F	20	3263	246	2285	26	180	36.0
100F	19	1233	276	1380	33	244	240.0
101F	13	883	186	750	20	92	21.8
102F	--	----	----	----	--	---	---
103F	--	----	----	----	--	---	---
104F	--	----	----	----	--	---	---
105F	24	2083	126	2220	15	223	42.0
106F	15	1178	141	1240	21	119	22.0
107F	30	888	201	670	13	181	18.4
108F	18	1378	211	1335	13	218	31.0
109F	10	1358	446	1000	18	295	24.2
110F	18	1738	166	1035	26	167	43.0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 1

SAMP. NO.	VOLUME (GAL.)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SUSPENDED SOLIDS (MG/L)	BOD (MG/L)	COD (MG/L)	GREASE (MG/L)
111F	23	678	146	610	20	241	34.0
112F	20	4643	586	4020	38	640	91.0
113F	12	713	156	635	16	276	41.0
114F	19	623	101	460	19	400	27.0
115F	12	508	121	400	13	229	26.4
116F	30	1068	206	825	16	306	43.2
117F	16	1418	261	1335	18	371	47.0
118F	14	643	221	515	18	185	38.0
119F	19	1008	216	805	10	272	41.0
120F	18	558	161	425	3	208	34.0
121F	17	713	186	755	12	348	38.0
122F	17	308	96	230	5	115	19.0
123F	16	153	21	135	5	113	12.0
124F	22	883	126	890	11	387	33.0
125F	22	863	331	460	13	174	32.0
126F	24	463	121	397	53	243	24.0
127F	26	573	176	280	51	355	25.0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
1F	----	---	---	--	--	--
2F	----	---	---	--	--	--
3F	----	---	---	--	--	--
4F	----	---	---	--	--	--
5F	----	---	---	--	--	--
6F	----	---	---	--	--	--
7F	0.53	0.02	1.09	118	11	3
8F*	0.17	0.02	0.78	161	3	3
9F	0.15	0.01	0.56	188	4	7
10F	0.12	0.00	2.39	262	5	9
11F*	0.12	0.02	2.79	117	4	9
12F	0.17	0.02	0.55	166	4	8
13F	0.10	0.01	1.54	102	4	2
14F	----	---	---	--	--	--
15F*	----	---	---	--	--	--
16F	----	---	---	--	--	--
17F	----	---	---	--	--	--
18F*	----	---	---	--	--	--
19F	----	---	---	--	--	--
20F	----	---	---	--	--	--
21F	0.50	0.01	1.62	316	5	12
22F	0.29	0.00	2.00	151	6	23

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
23F	0.27	0.01	2.22	336	6	20
24F*	0.16	0.03	1.16	201	2	4
25F	0.21	0.01	3.21	631	3	33
26F	0.25	0.04	3.36	611	4	28
27F	----	---	---	--	--	--
28F	----	---	---	--	--	--
29F	----	---	---	--	--	--
30F*	----	---	---	--	--	--
31F	----	---	---	--	--	--
32F	----	---	---	--	--	--
33F	1.14	0.02	2.02	77	0	71
34F	0.48	0.03	3.12	64	0	41
35F	0.17	0.00	0.33	87	4	17
36F	0.20	0.00	1.85	104	4	13
37F	----	---	---	--	--	--
38F	----	---	---	--	--	--
39F	----	---	---	--	--	--
40F	----	---	---	--	--	--
41F	----	---	---	--	--	--
42F	2.00	0.00	1.69	201	8	34
43F	1.64	0.01	1.85	151	5	37
44F	1.52	0.01	2.07	243	5	29

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
45F	1.16	0.01	1.54	243	7	11
46F	0.92	0.03	3.90	201	4	20
47F	----	---	---	--	--	--
48F	----	---	---	--	--	--
49F	----	---	---	--	--	--
50F	----	---	---	--	--	--
51F	0.72	0.02	0.48	64	6	5
52F	0.47	0.02	0.51	93	4	8
53F	1.04	0.02	0.05	30	10	15
54F	0.42	0.05	0.17	29	3	5
55F	0.36	0.01	0.11	50	3	3
56F	0.39	0.02	0.42	17	1	14
57F	0.38	0.32	0.81	17	0	14
58F	0.39	0.04	0.75	20	1	14
59F	0.39	0.03	0.78	17	6	19
60F	0.24	0.04	0.92	18	1	14
61F	----	---	---	--	--	--
62F	----	---	---	--	--	--
63F	----	---	---	--	--	--
64F	----	---	---	--	--	--
65F	----	---	---	--	--	--
66F	----	---	---	--	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
67F	----	---	---	--	--	--
68F	----	---	---	--	--	--
69F	----	---	---	--	--	--
70F	----	---	---	--	--	--
71F	----	---	---	--	--	--
72F	----	---	---	--	--	--
73F	0.54	0.01	1.57	111	0	10
74F	0.69	0.03	1.85	185	0	1
75F	0.42	0.02	1.54	175	0	2
76F	0.37	0.02	0.93	128	1	0
77F	0.36	0.01	1.01	191	3	4
78F	0.62	0.01	0.30	60	2	0
79F	0.68	0.16	0.55	37	4	0
80F	0.89	0.01	0.96	70	4	2
81F*	----	---	---	--	--	--
82F	0.94	0.20	2.30	44	5	5
83F	0.60	0.02	1.85	13	3	0
84F	1.62	0.04	0.17	141	2	0
85F	0.36	0.02	0.63	62	4	0
86F	1.61	0.07	1.51	262	12	1
87F*	----	---	---	--	--	--
88F	0.78	0.07	5.49	54	10	2

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
89F	0.45	0.02	1.99	27	3	1
90F	0.94	0.03	1.48	41	4	0
91F*	0.48	0.03	2.64	50	3	0
92F	0.45	0.06	1.85	67	2	0
93F	0.07	0.04	1.77	77	3	0
94F	0.48	0.11	1.72	117	3	0
95F	7.43	0.05	2.61	208	18	61
96F	3.41	0.01	1.24	89	7	14
97F	4.26	0.03	1.16	35	4	6
98F	3.05	0.01	1.39	154	3	3
99F	0.92	0.01	0.63	87	3	0
100F	0.78	0.01	1.69	168	4	0
101F	0.60	0.11	1.24	117	4	0
102F	----	---	---	--	--	--
103F	----	---	---	--	--	--
104F	----	---	---	--	--	--
105F	1.19	0.00	1.08	154	3	0
106F	0.66	0.03	1.05	92	2	0
107F	0.66	0.11	1.77	148	2	4
108F	0.54	0.06	1.24	268	3	0
109F	1.03	0.10	0.81	47	5	3
110F	0.60	0.02	0.60	54	4	0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 2

SAMP. NO.	TOTAL PO4-P (MG/L)	PO4-P (MG/L)	NO3-N (MG/L)	NO2-N (UG/L)	KJELD. N (MG/L)	CL (MG/L)
111F	0.54	0.04	0.78	34	3	0
112F	2.13	0.01	0.40	238	10	9
113F	0.87	0.01	1.06	319	7	7
114F	0.60	0.01	1.57	228	5	15
115F	0.75	0.01	1.24	221	4	8
116F	0.95	0.01	0.81	109	4	2
117F	1.01	0.05	0.93	109	5	2
118F	0.48	0.02	1.01	84	4	2
119F	0.49	0.03	1.54	154	5	6
120F	0.19	0.03	1.27	115	2	6
121F	0.20	0.02	1.09	44	3	4
122F	0.24	0.01	0.63	75	3	6
123F	0.03	0.04	0.33	27	2	1
124F	0.51	0.02	0.48	54	3	3
125F	0.39	0.03	0.30	74	3	8
126F	0.48	0.04	0.78	66	3	9
127F	0.48	0.06	0.02	87	3	8

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
1F	---	---	---	---	----	---	---
2F	---	---	---	---	----	---	---
3F	---	---	---	---	----	---	---
4F	---	---	---	---	----	---	---
5F	---	---	---	---	----	---	---
6F	---	---	---	---	----	---	---
7F	33.0	30.0	0.0	4500	0	0.0	0.00
8F*	15.0	12.8	---	190	0	0.0	0.00
9F	14.2	12.0	0.3	860	0	0.0	0.00
10F	13.8	11.0	1.6	430	0	0.0	0.00
11F*	12.2	9.1	0.8	440	0	0.0	0.00
12F	14.6	14.0	0.3	890	20	0.0	0.00
13F	11.8	8.0	0.5	690	35	0.0	0.00
14F	---	---	---	---	----	---	---
15F*	---	---	---	---	----	---	---
16F	---	---	---	---	----	---	---
17F	---	---	---	---	----	---	---
18F*	---	---	---	---	----	---	---
19F	---	---	---	---	----	---	---
20F	---	---	---	---	----	---	---
21F	30.2	24.4	2.6	0	0	0.0	0.00
22F	19.2	13.0	2.6	50	0	0.0	0.00

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
23F	18.0	10.6	5.3	170	10	0.0	0.00
24F*	13.0	10.4	---	10	0	0.0	0.00
25F	21.4	12.0	2.6	0	0	0.0	0.00
26F	18.0	10.6	2.6	0	0	0.0	0.00
27F	---	---	---	---	----	---	---
28F	---	---	---	---	----	---	---
29F	---	---	---	---	----	---	---
30F*	---	---	---	---	----	---	---
31F	---	---	---	---	----	---	---
32F	---	---	---	---	----	---	---
33F	7.8	6.0	1.3	3250	1750	---	---
34F	15.8	14.8	0.6	4120	47	---	---
35F	10.2	9.8	1.3	5200	100	---	---
36F	13.4	7.2	0.3	250	300	---	---
37F	---	---	---	---	----	---	---
38F	---	---	---	---	----	---	---
39F	---	---	---	---	----	---	---
40F	---	---	---	---	----	---	---
41F	---	---	---	---	----	---	---
42F	23.8	21.4	5.1	5	180	---	---
43F	20.8	14.0	2.8	60	65	---	---
44F	17.2	6.8	2.1	100	30	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
45F	37.0	28.0	1.8	10	20	0.0	---
46F	19.2	18.8	9.0	95	140	---	---
47F	---	---	---	---	----	---	---
48F	---	---	---	---	----	---	---
49F	---	---	---	---	----	---	---
50F	---	---	---	---	----	---	---
51F	31.2	26.8	0.0	105	110	0.0	---
52F	33.8	22.4	0.0	185	75	---	---
53F	42.2	30.8	3.8	0	270	---	---
54F	20.2	14.8	0.0	0	75	---	---
55F	23.6	20.0	1.3	550	305	---	---
56F	25.6	10.8	5.1	285	105	0.0	---
57F	25.8	13.0	2.3	185	50	---	---
58F	16.2	13.0	1.3	140	30	---	---
59F	26.0	13.8	2.6	70	240	---	---
60F	6.8	4.4	0.0	125	295	---	---
61F	---	---	---	---	----	---	---
62F	---	---	---	---	----	---	---
63F	---	---	---	---	----	---	---
64F	---	---	---	---	----	---	---
65F	---	---	---	---	----	---	---
66F	---	---	---	---	----	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
67F	---	---	---	---	----	---	---
68F	---	---	---	---	----	---	---
69F	---	---	---	---	----	---	---
70F	---	---	---	---	----	---	---
71F	---	---	---	---	----	---	---
72F	---	---	---	---	----	---	---
73F	15.6	14.0	0.0	95	10	---	---
74F	20.8	17.4	2.6	0	50	---	---
75F	15.8	8.6	0.0	0	0	---	---
76F	23.0	9.2	0.0	0	0	---	---
77F	24.0	21.4	2.6	0	10	---	---
78F	41.6	19.2	0.0	0	190	---	---
79F	38.0	24.6	2.6	2415	135	---	---
80F	36.0	22.6	0.0	0	5	0.0	---
81F*	---	---	---	---	----	---	---
82F	47.2	35.6	0.0	0	0	---	---
83F	60.8	54.6	0.0	0	0	---	---
84F	63.8	59.2	0.0	1885	465	---	---
85F	23.4	20.2	0.0	0	1795	---	---
86F	71.2	60.6	5.1	0	0	0.0	---
87F*	---	---	---	---	----	---	---
88F	24.0	23.0	0.0	0	30	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
89F	39.8	31.6	1.3	0	0	---	---
90F	36.0	32.2	6.4	0	0	---	---
91F*	23.8	21.2	0.0	0	0	---	---
92F	20.8	12.6	0.0	0	0	0.0	---
93F	16.6	10.8	0.0	0	0	---	---
94F	9.2	8.2	0.0	0	0	---	---
95F	86.4	83.6	5.1	0	200	---	---
96F	14.8	7.2	2.6	625	195	---	---
97F	23.8	13.8	1.3	110000	0	---	---
98F	8.4	8.2	0.0	165	1485	---	---
99F	26.3	17.4	0.0	550000	55	---	---
100F	21.4	20.4	0.0	15	45	---	---
101F	6.2	12.2	0.0	3145	0	---	---
102F	---	---	---	---	----	---	---
103F	---	---	---	---	----	---	---
104F	---	---	---	---	----	---	---
105F	21.0	21.0	5.1	3150	340	---	---
106F	10.0	7.4	2.6	0	25	---	---
107F	10.0	9.0	0.0	10	35	---	---
108F	17.2	10.0	2.6	0	1150	---	---
109F	16.6	13.6	0.0	55	1800	---	---
110F	18.4	10.4	2.6	265	675	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 3

SAMP. NO.	PETRO. (MG/L)	N-PAR. (MG/L)	ASBESTOS (FBRS/L) X10EXP-5	FECAL COLIFORM (ORG/100ML)	FECAL STREP (ORG/100ML)	CN (MG/L)	CR+6 (MG/L)
111F	15.0	15.0	0.0	36	140	---	---
112F	51.0	27.0	5.1	0	125	---	---
113F	20.0	21.0	1.3	0	25	---	---
114F	16.0	15.0	0.0	25	30	---	---
115F	20.0	15.0	1.3	67000	2805	---	---
116F	19.0	19.0	---	0	710	---	---
117F	18.0	23.6	---	0	550	---	---
118F	17.0	17.0	---	0	740	---	---
119F	20.0	12.0	---	0	0	---	---
120F	12.0	13.0	---	30	605	---	---
121F	21.0	17.0	---	100000	335	---	---
122F	10.0	7.0	---	17350	2430	---	---
123F	11.0	7.2	---	70	515	---	---
124F	17.0	15.0	---	5500	500	---	---
125F	16.0	15.0	---	63500	6050	---	---
126F	12.0	11.0	---	450	3300	---	---
127F	12.0	12.0	---	350	35010	---	---

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE B-3 (CONTINUED). ANALYSES OF FLUSH - PART 4

SAMP. NO.	METAL CONTENT (MG/L) LEAD	CHROMIUM	COPPER	NICKEL	ZINC	MERCURY
7F	10.40	0.1	0.29	0.34	1.78	0
9F	0.56	0.1	0.07	0.07	0.42	0
10F	1.07	0.1	0.07	0.08	0.59	0.02
12F	1.48	0.1	0.10	0.12	1.04	0.01
13F	1.12	0.1	0.09	0.10	0.47	0
21F	34.00	0.2	0.26	0.33	2.96	0
22F	21.60	0.1	0.16	0.27	1.72	0
23F	14.00	0.1	0.15	0.19	1.10	0.01
25F	8.40	0.1	0.18	0.16	0.93	0
26F	8.00	0.1	0.22	0.18	0.81	0

APPENDIX C

POLLUTANT LOADS ON ROADWAYS

TABLE C-1. POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
1L	17.15	4.3	0.00	0.0045	0.182
2L	0.28	0.1	0.07	----	---
3L	0.04	0.0	0.01	----	---
4L	0.01	0.0	0.00	----	---
5L	0.03	0.0	0.01	----	---
6L	0.07	0.0	0.00	----	---
7L	140.43	535.5	117.27	0.0829	32.285
8L*	3.35	1.2	0.30	0.0017	0.187
9L	17.02	20.0	0.82	0.0289	1.605
10L	12.08	12.0	2.31	0.0037	1.360
11L*	28.05	24.0	1.36	0.0073	2.140
12L	18.32	8.0	0.58	0.0051	0.562
13L	138.10	79.9	16.49	0.0497	13.561
14L	182.96	54.4	9.13	0.0658	7.007
15L*	5.19	8.0	2.06	0.0077	0.211
16L	58.71	28.0	7.63	0.1245	2.272
17L	103.27	56.0	18.23	0.0371	3.160
18L*	259.85	111.9	29.78	0.0858	4.703
19L	40.57	24.0	6.10	0.0081	7.761
20L	140.12	48.0	12.75	0.0532	2.676
21L	35.35	12.0	2.63	0.0138	1.428
22L	18.46	6.0	3.66	0.0199	1.673

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-1 (CONTINUED). POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
23L	18.99	6.0	2.47	0.0196	2.075
24L*	30.21	12.0	0.91	0.0432	1.474
25L	22.53	5.4	2.68	0.0608	1.440
26L	9.22	3.0	0.83	0.0240	0.427
27L	15.10	28.2	12.61	0.2840	5.034
28L	7.75	21.0	6.53	0.1153	1.219
29L	18.39	33.0	16.56	0.2144	6.935
30L*	3.69	18.0	2.83	0.0607	1.713
31L	6.31	18.0	5.34	0.1072	4.078
32L	7.73	18.0	6.67	0.1275	7.185
33L	143.98	57.0	35.61	0.5457	11.345
34L	22.64	14.0	8.75	0.1191	3.796
35L	15.52	16.0	12.30	0.0576	2.044
36L	14.52	14.0	3.11	0.1635	2.167
37L	355.53	95.6	74.63	1.6888	21.404
38L	30.84	13.9	17.43	0.0423	5.895
39L	31.36	13.9	9.65	0.1741	4.849
40L	48.00	19.9	8.85	0.6994	12.730
41L	281.10	95.9	154.83	4.4808	40.619
42L	26.04	12.0	14.07	0.5259	4.835
43L	19.01	15.0	2.52	0.3468	3.345
44L	76.94	33.9	4.64	0.7225	19.598

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-1 (CONTINUED). POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
45L	20.24	16.5	13.54	0.1540	7.159
46L	25.31	21.0	7.04	0.2908	6.646
47L	13.56	30.0	11.77	0.1334	5.718
48L	4.62	14.4	3.90	0.0551	1.530
49L	20.42	38.4	17.24	0.3170	21.685
50L	13.86	16.8	11.37	0.2556	13.550
51L	453.70	143.9	343.67	7.6492	468.106
52L	42.07	26.4	13.85	0.5643	21.403
53L	99.15	95.9	91.92	1.8112	71.794
54L	82.95	67.1	49.09	1.0836	54.131
55L	107.08	69.5	36.98	1.5326	98.222
56L	16.18	13.4	8.82	0.1409	14.866
57L	19.28	17.3	7.41	0.1679	8.419
58L	6.37	7.7	3.01	0.0637	5.231
59L	20.64	9.6	7.94	0.2124	14.439
60L	14.77	12.5	11.00	0.1565	15.303
61L	334.61	99.9	59.49	0.4751	36.604
62L	43.85	12.0	4.65	0.0846	2.666
63L	26.03	6.0	12.63	0.0526	5.313
64L	23.91	12.0	13.50	0.0837	2.336
65L	15.24	6.0	4.11	0.0195	0.826
66L	17.81	14.0	4.30	0.0481	4.510

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-1 (CONTINUED). POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
67L	719.89	255.8	37.86	2.5771	95.524
68L	36.03	16.0	4.64	0.0526	5.048
69L	15.30	8.0	3.13	0.0202	2.100
70L	17.59	10.0	4.20	0.0301	4.360
71L	30.70	8.0	3.84	0.0586	3.678
72L	24.48	10.0	5.04	0.0326	3.195
73L	48.90	9.0	6.74	0.1418	3.418
74L	32.61	10.5	10.31	0.0783	1.894
75L	26.40	9.0	6.25	0.0525	3.577
76L	19.20	9.0	5.11	0.0484	2.212
77L	12.01	4.5	2.13	0.0340	1.567
78L	72.81	30.7	34.49	0.2445	10.180
79L	25.94	5.8	8.04	0.0747	3.925
80L	40.64	34.5	12.43	0.4470	6.348
81L*	34.68	15.4	23.55	0.2199	3.929
82L	16.25	7.7	2.74	0.1215	1.691
83L	6.22	3.8	1.60	0.0415	2.461
84L	72.77	30.7	18.37	0.2700	9.503
85L	8.42	3.8	3.85	0.0207	1.831
86L	16.48	7.7	1.66	0.0671	2.401
87L*	23.98	7.7	15.41	0.0741	1.846
88L	11.03	5.8	2.70	0.0419	3.275

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-1 (CONTINUED). POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
89L	4.86	3.1	2.45	0.0235	1.637
90L	1600.64	420.8	104.20	5.6179	139.568
91L*	176.68	69.2	38.96	1.3444	24.186
92L	66.08	26.6	10.82	0.1057	24.110
93L	48.92	21.3	11.02	0.4080	21.836
94L	69.06	25.6	4.50	0.5207	31.725
95L	611.74	152.4	28.81	1.0766	244.060
96L	42.51	14.2	1.37	0.2270	17.435
97L	7.31	6.1	0.80	0.0537	2.679
98L	8.28	2.6	0.24	0.0242	2.314
99L	85.76	24.0	14.80	0.5900	6.843
100L	32.78	12.0	3.45	0.1806	3.094
101L	15.37	8.0	1.71	0.0629	2.233
102L	132.37	47.9	1.38	0.6830	21.720
103L	35.29	16.0	2.66	0.1835	13.627
104L	26.59	6.4	1.95	0.0776	8.254
105L	38.51	9.0	1.85	0.3354	6.570
106L	26.05	9.0	3.92	0.3230	6.322
107L	22.78	9.0	5.97	0.3544	5.173
108L	65.99	15.0	5.63	1.0709	9.317
109L	173.04	191.8	21.70	1.2078	44.124
110L	11.40	13.4	7.12	0.1903	2.684

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-1 (CONTINUED). POLLUTANT LOADS ON ROADWAYS - LITTER

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI
111L	214.70	118.9	109.85	3.0468	71.501
112L	282.20	73.1	14.08	1.6310	114.536
113L	27.97	8.1	0.64	0.4478	7.605
114L	20.07	6.1	0.42	0.2881	8.052
115L	25.28	8.1	0.78	0.5683	9.371
116L	65.99	51.0	19.64	0.6650	21.209
117L	58.52	25.5	4.16	0.6881	8.537
118L	31.50	9.6	4.76	0.3005	10.556
119L	207.56	51.0	43.38	1.1955	76.609
120L	57.11	25.5	12.11	0.6516	18.737
121L	38.19	25.5	5.94	0.9615	14.002
122L	43.99	12.8	12.79	0.4042	11.173
123L	19.69	30.7	7.44	0.3211	5.292
124L	4.21	2.9	0.49	0.0750	1.565
125L	27.58	13.4	15.26	0.6740	15.498
126L	44.62	30.7	15.59	0.9549	28.924
127L	41.50	30.7	8.37	0.6911	23.708

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2. POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
1D	130.32	71.9	12.13	0.3753	9.096	0.078
2D	17.12	7.2	1.82	0.0430	2.910	0.010
3D	13.17	6.3	1.70	0.0615	2.233	0.032
4D	7.64	1.7	0.72	0.0482	1.420	0.116
5D	12.69	4.3	1.46	0.0936	2.820	0.093
6D	8.14	2.6	1.22	0.0667	2.019	0.138
7D	394.10	484.4	13.75	0.6187	74.287	3.429
8D*	13.14	4.0	1.08	0.0279	2.723	0.277
9D	36.60	20.0	4.60	0.0618	6.148	0.512
10D	53.56	40.0	6.53	0.0445	9.945	0.471
11D*	27.45	8.0	2.65	0.0502	4.389	0.294
12D	52.02	14.8	3.86	0.1119	4.760	0.551
13D	219.51	63.9	16.62	0.2304	7.244	1.361
14D	181.85	44.4	16.17	0.2491	9.093	1.418
15D*	35.96	10.0	4.25	0.0640	4.149	0.507
16D	222.01	61.9	13.50	0.3174	31.304	1.576
17D	327.42	71.9	20.23	0.4518	47.443	3.733
18D*	167.59	55.9	14.66	0.1743	36.299	1.626
19D	228.72	67.9	13.95	0.7731	15.095	2.104
20D	352.21	95.9	12.15	0.2430	11.623	2.994
21D	239.61	59.9	16.29	0.4361	27.148	2.133
22D	273.73	71.9	18.64	0.4872	23.431	3.093

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
23D	188.37	50.9	15.18	0.3447	17.481	2.260
24D*	341.21	89.9	12.11	0.6824	23.680	2.013
25D	392.85	107.9	17.95	1.3750	30.485	3.221
26D	176.87	48.0	18.98	0.3449	16.378	1.928
27D	258.26	80.3	32.93	2.5232	62.009	4.881
28D	70.11	21.9	11.95	0.4964	15.172	1.500
29D	121.01	66.8	42.18	0.5857	27.759	1.730
30D*	92.44	27.0	7.34	0.6693	7.931	0.841
31D	111.14	33.0	12.30	0.5701	14.392	1.623
32D	108.85	31.5	6.74	0.5486	11.626	1.197
33D	301.71	95.3	18.53	0.7633	21.180	1.750
34D	48.66	19.5	4.39	0.1664	4.278	0.355
35D	47.43	14.0	3.89	0.1703	3.870	0.455
36D	39.91	14.4	2.99	0.1197	4.434	0.535
37D	608.13	170.1	24.39	1.2831	27.974	3.284
38D	124.61	35.8	4.11	0.2654	6.941	0.735
39D	108.74	23.9	5.17	0.3958	7.394	0.794
40D	125.05	35.8	10.68	0.3589	10.604	1.000
41D	848.57	214.0	37.42	1.9093	34.028	4.837
42D	226.24	58.3	11.13	0.4796	16.267	1.516
43D	304.99	80.9	11.83	0.6954	16.530	1.708
44D	777.89	207.1	46.60	1.9758	44.262	4.512

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
45D	197.94	61.4	14.63	0.4275	15.637	2.850
46D	398.87	106.1	19.54	0.8775	21.539	2.952
47D	289.68	91.1	30.70	1.6781	35.472	5.324
48D	63.56	20.1	7.29	0.4539	10.900	1.244
49D	139.12	57.6	27.60	1.1186	34.599	1.918
50D	35.30	13.4	5.00	0.2574	8.447	0.874
51D	696.94	194.2	47.06	3.4457	74.204	12.321
52D	143.03	42.2	8.86	0.6757	18.157	2.429
53D	365.29	80.3	23.06	1.7841	32.544	3.940
54D	145.25	38.9	9.18	0.7051	72.394	2.553
55D	165.70	46.5	10.06	0.7398	17.080	2.747
56D	156.95	43.2	18.05	0.6090	11.708	1.397
57D	68.03	19.8	13.80	0.2830	6.259	0.735
58D	43.29	13.4	2.53	0.2359	3.818	0.533
59D	147.38	57.0	11.35	0.9094	11.113	1.489
60D	46.30	13.4	2.83	0.3375	5.551	0.699
61D	485.24	123.9	19.99	1.5236	35.760	5.677
62D	99.95	32.0	7.48	0.1869	6.936	1.029
63D	18.36	4.0	0.94	0.0494	1.065	0.204
64D	26.89	8.0	2.61	0.0815	2.270	0.229
65D	23.01	8.0	1.65	0.0700	1.772	0.274
66D	46.93	16.0	3.90	0.2412	4.688	0.741

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
67D	1658.13	449.6	71.79	2.9181	73.285	9.285
68D	103.40	28.0	5.36	0.2337	6.472	0.993
69D	78.46	22.0	2.90	0.2024	4.943	0.730
70D	78.39	22.0	3.63	0.2430	6.185	0.698
71D	89.32	24.0	3.82	0.1715	5.028	0.572
72D	105.10	28.0	6.93	0.2417	6.316	0.925
73D	486.74	128.9	16.01	0.7204	17.474	2.823
74D	347.13	98.9	15.97	0.7289	17.147	2.117
75D	358.12	97.4	13.93	0.6303	19.159	2.113
76D	318.65	89.9	14.05	0.3664	16.155	2.167
77D	414.22	101.9	14.95	0.5468	24.852	2.858
78D	430.37	121.0	16.57	2.1261	29.050	4.863
79D	46.78	13.6	2.02	0.1366	4.458	0.487
80D	197.31	51.6	7.50	0.4282	15.213	2.249
81D*	353.50	99.8	11.91	1.1064	30.896	4.313
82D	143.90	51.8	13.44	0.4087	18.190	2.130
83D	38.38	13.4	2.68	0.1067	4.444	0.710
84D	1637.32	456.6	40.77	1.9157	74.662	14.245
85D	70.54	17.3	3.01	0.1855	6.250	0.861
86D	107.26	30.7	5.46	0.2263	7.841	1.705
87D*	277.22	78.7	14.42	1.1089	18.214	2.523
88D	105.53	30.7	8.19	0.1836	13.982	1.805

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
89D	46.03	15.4	2.72	0.0727	5.146	0.746
90D	1691.10	399.3	68.82	2.3505	75.588	12.006
91D*	414.19	101.5	21.79	0.5674	32.967	5.550
92D	192.21	53.3	8.90	0.3267	15.164	2.287
93D	200.88	54.6	9.90	0.6448	17.556	1.225
94D	183.29	53.3	9.86	0.3262	15.267	2.199
95D	888.35	292.6	98.86	0.9149	53.385	7.106
96D	39.40	14.2	22.93	0.0843	3.802	0.457
97D	15.73	5.1	1.65	0.0886	1.559	0.307
98D	23.83	4.1	2.08	0.0882	2.223	0.384
99D	153.29	43.2	8.42	0.3725	8.599	1.119
100D	39.22	12.0	1.79	0.0879	2.851	0.326
101D	43.27	15.2	2.38	0.1333	3.033	0.350
102D	206.96	63.9	7.08	0.3684	10.658	1.428
103D	106.94	32.0	3.86	0.2139	7.196	0.909
104D	75.02	23.2	3.24	0.1635	4.974	0.540
105D	345.80	95.9	9.61	0.5429	20.436	2.386
106D	236.83	59.9	8.29	0.3647	10.965	1.468
107D	201.02	59.9	7.90	0.3317	12.644	1.387
108D	410.93	119.9	19.20	0.7068	27.942	3.000
109D	733.57	231.3	37.49	2.7216	81.500	7.262
110D	122.82	38.4	5.05	0.2678	9.715	0.995

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 1

SAMP. NO.	DRY WEIGHT #/MI	DRY VOLUME QT/MI	VOLATILE SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
111D	131.63	42.2	6.74	0.7292	10.360	1.290
112D	200.35	52.8	8.87	0.2023	15.105	1.643
113D	42.12	10.2	2.51	0.1171	4.204	0.463
114D	51.48	15.4	2.84	0.0849	4.190	0.278
115D	28.35	8.9	1.78	0.1074	2.355	0.320
116D	217.11	63.8	7.77	0.4603	13.374	1.997
117D	289.86	86.1	16.81	0.8116	24.898	3.420
118D	106.65	25.5	5.76	0.3178	12.222	1.536
119D	700.69	197.7	18.22	1.0160	39.308	4.064
120D	171.53	51.0	8.92	0.2195	14.940	2.058
121D	190.17	51.0	9.22	0.4317	15.023	1.559
122D	204.20	57.4	10.23	0.3390	18.603	2.083
123D	64.22	19.2	3.57	0.1612	5.150	0.604
124D	32.70	6.9	1.44	0.0625	2.570	0.330
125D	77.66	23.0	3.63	0.1196	5.669	0.792
126D	146.46	36.4	9.70	0.4921	19.699	2.080
127D	105.95	34.5	6.35	0.1897	8.498	0.996

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P	PO4-P	NO3-N	NO2-N	KJELD. N	CL
	2	2	2	2	0	0
1D	2.698	0.104	0.094	0.019	0.188	0.008
2D	0.676	0.038	0.007	0.014	0.046	0.003
3D	0.283	0.024	0.011	0.015	0.040	0.002
4D	0.097	0.015	0.007	0.003	0.014	0.001
5D	0.282	0.006	0.034	0.010	0.047	0.002
6D	0.139	0.025	0.011	0.016	0.025	0.001
7D	15.882	0.236	0.469	0.000	0.631	0.087
8D*	0.610	0.001	0.010	0.000	0.019	0.005
9D	1.427	0.004	0.013	0.002	0.017	0.012
10D	2.378	0.027	0.039	0.001	0.104	0.011
11D*	0.604	0.003	0.005	0.013	0.028	0.009
12D	1.550	0.031	0.025	0.019	0.043	0.013
13D	3.578	0.000	0.099	0.000	0.083	0.026
14D	7.183	0.036	0.047	0.000	0.042	0.018
15D*	0.937	0.000	0.024	0.001	0.034	0.006
16D	8.570	0.022	0.038	0.018	0.100	0.047
17D	7.334	0.065	0.187	0.002	0.154	0.062
18D*	9.318	0.017	0.044	0.005	0.075	0.049
19D	4.917	0.023	0.043	0.002	0.066	0.048
20D	7.749	0.000	0.187	0.001	0.134	0.049
21D	12.747	0.000	0.800	0.014	0.117	0.022
22D	10.812	2.272	0.679	0.038	0.115	0.096

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
23D	5.613	1.526	0.624	0.029	0.064	0.053
24D*	8.496	0.239	0.812	0.087	0.092	0.058
25D	14.378	0.314	1.135	0.112	0.114	0.114
26D	4.829	0.000	0.317	0.058	0.087	0.039
27D	5.475	0.025	0.315	0.001	0.065	0.072
28D	1.409	0.056	0.196	0.000	0.074	0.020
29D	2.795	0.242	0.209	0.000	0.217	0.025
30D*	---	---	---	---	0.023	0.011
31D	1.666	0.256	0.338	0.000	0.027	0.023
32D	1.731	0.457	0.251	0.000	0.025	0.040
33D	6.327	0.602	0.431	0.001	0.124	0.066
34D	0.756	0.445	0.144	0.000	0.015	0.009
35D	1.874	0.016	0.048	0.000	0.019	0.014
36D	1.027	0.003	0.054	0.000	0.040	0.010
37D	9.222	0.880	0.637	0.000	0.049	0.147
38D	2.199	0.541	0.305	0.000	0.011	0.023
39D	0.015	0.008	0.073	0.001	0.026	0.032
40D	0.017	0.000	0.116	0.001	0.028	0.022
41D	19.178	0.000	---	0.007	0.356	1.205
42D	8.393	0.000	0.482	0.001	0.100	0.260
43D	7.442	0.000	0.641	0.001	0.089	0.384
44D	17.814	0.000	1.159	0.014	0.156	0.420

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
45D	7.007	0.000	0.253	0.001	0.046	0.052
46D	8.576	0.000	0.642	0.005	0.080	0.547
47D	4.224	0.608	0.616	0.001	0.385	0.067
48D	0.946	0.203	0.182	0.000	0.066	0.013
49D	1.529	0.709	0.491	0.001	0.152	0.046
50D	0.568	0.060	0.099	0.001	0.026	0.008
51D	11.138	0.627	1.058	0.003	0.404	0.285
52D	2.271	0.000	0.210	0.001	0.073	0.034
53D	5.327	0.110	0.387	0.001	0.230	0.058
54D	3.003	0.189	0.283	0.000	0.067	0.034
55D	2.665	0.000	0.296	0.001	0.078	0.030
56D	2.590	0.220	0.234	0.000	0.055	0.075
57D	1.810	0.143	0.092	0.000	0.008	0.027
58D	1.082	0.061	0.058	0.000	0.008	0.012
59D	2.668	0.310	0.161	0.000	0.030	0.060
60D	0.801	0.190	0.070	0.000	0.024	0.023
61D	13.004	0.000	0.607	0.007	0.359	0.102
62D	2.069	0.000	0.289	0.000	0.059	0.031
63D	0.516	0.000	0.041	0.000	0.012	0.091
64D	0.740	0.000	0.067	0.000	0.018	0.090
65D	0.679	0.005	0.058	0.000	0.007	0.053
66D	1.633	0.052	0.084	0.001	0.008	0.195

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
67D	34.321	0.000	0.730	0.003	0.846	0.232
68D	2.368	0.000	0.244	0.003	0.046	0.042
69D	1.867	0.000	0.089	0.002	0.028	0.057
70D	1.726	0.000	0.102	0.002	0.027	0.128
71D	2.072	0.000	0.080	0.001	0.030	0.072
72D	2.375	0.000	0.218	0.003	0.027	0.120
73D	12.947	0.000	0.414	0.023	0.024	0.307
74D	10.795	0.000	0.698	0.008	0.014	0.160
75D	8.630	0.000	0.491	0.005	0.022	0.190
76D	8.157	0.000	0.449	0.004	0.042	0.159
77D	10.272	0.041	1.147	0.001	0.070	0.273
78D	5.035	0.043	1.098	0.001	0.108	0.082
79D	1.081	0.009	0.131	0.000	0.018	0.014
80D	2.881	0.118	0.288	0.000	0.055	0.124
81D*	---	---	---	---	---	0.035
82D	2.950	0.144	0.176	0.000	0.037	0.065
83D	0.645	0.019	0.068	0.000	0.028	0.012
84D	18.993	1.637	1.539	0.002	0.295	0.295
85D	1.404	0.007	0.163	0.000	0.028	0.020
86D	2.295	0.333	0.216	0.000	0.050	0.047
87D*	---	---	---	---	---	0.039
88D	2.828	0.116	0.121	0.000	0.045	0.048

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P	PO4-P	NO3-N	NO2-N	KJELD. N	CL
	2	2	2	2	0	0
89D	0.759	0.032	0.059	0.000	0.024	0.015
90D	22.656	0.169	2.756	0.003	0.490	0.101
91D*	7.372	0.207	0.969	0.001	0.137	0.095
92D	3.517	0.135	0.223	0.000	0.075	0.044
93D	3.193	0.000	0.434	0.000	0.086	0.056
94D	3.922	0.367	0.491	0.000	0.075	0.053
95D	27.803	0.000	0.293	0.008	0.320	0.728
96D	1.418	0.000	0.054	0.001	0.022	0.018
97D	0.662	0.000	0.029	0.000	0.000	0.017
98D	1.389	0.002	0.049	0.000	0.000	0.020
99D	4.016	0.000	0.279	0.000	0.069	0.020
100D	0.859	0.000	0.094	0.000	0.027	0.010
101D	1.398	0.273	0.179	0.000	0.035	0.012
102D	4.491	0.000	0.240	0.000	0.068	0.033
103D	2.107	0.000	0.663	0.001	0.046	0.017
104D	2.153	0.083	0.566	0.000	0.059	0.024
105D	7.815	0.000	0.588	0.001	0.080	0.104
106D	6.631	0.000	0.592	0.000	0.064	0.114
107D	5.649	0.925	0.734	0.000	0.054	0.109
108D	12.780	1.931	0.604	0.000	0.111	0.181
109D	23.108	6.969	1.474	0.000	0.499	0.183
110D	2.813	0.688	0.269	0.000	0.055	0.015

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
111D	3.528	1.211	0.304	0.000	0.045	0.033
112D	4.027	0.000	0.194	0.000	0.086	0.036
113D	1.028	0.004	0.073	0.000	0.038	0.024
114D	1.318	0.098	0.156	0.000	0.041	0.034
115D	0.539	0.003	0.058	0.000	0.007	0.013
116D	4.494	0.890	0.582	0.000	0.119	0.028
117D	9.739	1.420	1.006	0.000	0.371	0.029
118D	2.474	0.587	0.266	0.000	0.050	0.038
119D	8.128	1.051	1.212	0.001	0.231	0.063
120D	1.887	0.309	0.604	0.000	0.094	0.045
121D	1.750	0.209	0.435	0.000	0.108	0.021
122D	2.246	0.429	0.560	0.000	0.104	0.031
123D	1.111	0.619	0.127	0.000	0.035	0.020
124D	0.700	0.000	0.064	0.000	0.015	0.006
125D	3.029	0.000	0.165	0.000	0.043	0.020
126D	5.712	1.631	0.170	0.000	0.136	0.035
127D	5.009	0.828	0.338	0.000	0.073	0.031

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
1D	0.052	0.000	0	---	0.0	0.0	0.000	0.00
2D	0.003	0.000	7693	---	0.0	0.0	0.000	0.00
3D	0.009	0.000	0	---	0.0	0.0	0.000	0.00
4D	0.044	0.034	382	---	0.0	0.0	0.000	0.00
5D	0.025	0.023	749	---	0.0	0.0	0.000	0.00
6D	0.057	0.040	185	---	----	----	0.000	0.00
7D	2.365	1.419	0	---	0.0	0.0	0.000	0.00
8D*	0.149	0.114	----	---	240.0	0.0	0.000	0.00
9D	0.242	0.209	500	---	660.0	0.0	0.000	0.00
10D	0.230	0.187	0	---	330.0	0.0	0.000	0.00
11D*	0.165	0.137	----	---	3700.0	0.0	0.000	0.00
12D	0.219	0.198	0	0.333	25.0	0.0	0.000	0.00
13D	0.461	0.373	2990	1.142	0.0	0.0	0.000	0.00
14D	0.600	0.527	5779	---	0.0	0.0	0.000	0.00
15D*	0.262	0.180	----	---	1.6	0.0	0.000	0.00
16D	0.710	0.666	0	---	35.0	0.0	0.000	0.00
17D	0.982	0.851	1487	1.310	0.0	0.0	0.000	0.00
18D*	0.721	0.670	----	---	0.0	0.0	0.000	0.00
19D	0.938	0.846	4154	2.470	0.0	0.0	0.000	0.00
20D	1.092	0.986	0	---	24.0	40.0	0.000	0.00
21D	1.174	0.982	7615	---	0.0	0.0	0.000	0.00
22D	1.423	1.369	4971	---	31.0	0.0	0.000	0.00

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
23D	1.074	0.791	7697	---	0.0	30.0	0.000	0.00
24D*	1.262	0.955	----	3.412	0.0	0.0	0.000	0.00
25D	1.454	1.021	14269	3.143	0.0	0.0	0.000	0.00
26D	1.026	0.831	4015	1.556	0.0	0.0	0.000	0.00
27D	1.601	1.265	0	---	0.0	64.4	0.000	0.00
28D	0.498	0.407	0	---	0.0	27.0	0.000	0.00
29D	0.629	0.496	2637	---	0.0	25.0	0.000	--
30D*	0.813	0.693	336	---	0.0	69.0	0.000	--
31D	0.655	0.567	0	0.302	0.0	33.0	0.000	--
32D	0.577	0.316	395	0.670	0.0	120.0	0.000	--
33D	0.643	0.456	4131	---	1150.0	83.0	---	--
34D	0.141	0.131	1777	---	404.5	1.6	---	--
35D	0.205	0.163	649	0.134	0.0	1.1	---	--
36D	0.299	0.148	1457	0.096	0.0	0.1	---	--
37D	1.132	0.922	13898	---	0.0	100.5	0.000	--
38D	0.318	0.266	2848	---	0.0	0.4	0.000	--
39D	0.345	0.292	1491	0.744	0.0	0.3	---	--
40D	0.397	0.336	1715	0.656	0.0	0.0	---	--
41D	3.225	1.867	196484	---	0.0	1194.3	---	--
42D	0.905	0.815	26706	---	0.0	534.1	---	--
43D	0.915	0.702	105236	1.220	0.0	163.4	---	--
44D	2.100	1.867	226031	3.734	0.0	1765.9	---	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
45D	1.326	0.337	45832	---	0.0	204.9	0.000	--
46D	1.436	0.957	101411	---	45.3	294.3	---	--
47D	1.881	1.765	59182	---	0.0	368.2	---	--
48D	0.451	0.038	7214	0.527	0.0	27.4	0.000	--
49D	0.834	0.584	12000	0.889	0.0	41.1	0.000	--
50D	0.300	0.215	6089	---	0.0	11.2	---	--
51D	5.221	2.576	60118	---	0.0	197.8	0.000	--
52D	1.186	0.943	12337	---	0.0	3.3	---	--
53D	0.839	0.401	41460	0.438	0.0	45.6	---	--
54D	1.103	0.769	3297	---	0.0	18.1	---	--
55D	1.291	1.192	9780	0.712	90.3	7.5	---	--
56D	0.753	0.612	18526	---	0.0	17.8	---	--
57D	0.408	0.313	4015	0.327	0.0	6.2	---	--
58D	0.342	0.242	7469	---	0.0	13.8	0.000	--
59D	0.737	0.501	8699	---	0.0	73.6	---	--
60D	0.389	0.315	7987	0.454	0.0	10.5	---	--
61D	3.639	2.911	13218	---	0.0	44.1	---	--
62D	0.680	0.310	5899	0.480	0.0	128.2	---	--
63D	0.152	0.134	0	---	0.0	0.2	---	--
64D	0.210	0.153	3175	---	0.0	37.9	---	--
65D	0.209	0.145	3969	---	0.0	1.3	0.000	--
66D	0.446	0.436	2770	0.319	0.0	11.7	---	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
67D	5.803	2.984	0	---	0.0	75.3	---	--
68D	0.620	0.476	0	0.259	0.0	2.4	---	--
69D	0.424	0.345	9262	---	0.0	2.7	---	--
70D	0.353	0.314	0	---	0.0	0.9	0.000	--
71D	0.393	0.268	0	---	0.0	12.2	---	--
72D	0.673	0.578	6203	0.378	0.0	0.0	---	--
73D	1.801	1.655	112700	---	0.0	27.6	---	--
74D	1.007	0.729	40795	1.180	0.0	3.9	---	--
75D	1.576	1.432	21136	1.361	0.0	0.0	---	--
76D	1.498	1.020	37613	0.510	0.0	0.0	---	--
77D	1.740	1.533	0	---	0.0	4.7	---	--
78D	3.572	2.152	25401	---	0.0	385.9	---	--
79D	0.304	0.239	8071	0.281	0.0	12.2	---	--
80D	1.381	1.302	23290	---	0.0	0.0	---	--
81D*	2.651	2.510	----	---	----	----	0.000	--
82D	1.252	0.933	24826	0.892	0.0	0.0	---	--
83D	0.476	0.365	2265	---	0.0	0.9	---	--
84D	7.368	6.058	44601	---	0.0	204.4	---	--
85D	0.480	0.388	12170	0.282	0.0	5.6	---	--
86D	0.965	0.740	0	---	0.0	0.0	---	--
87D*	1.663	1.248	----	---	----	----	0.000	--
88D	1.024	0.739	2875	0.971	0.0	0.0	---	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
89D	0.460	0.368	0	---	0.0	0.5	---	--
90D	8.117	5.073	196566	---	0.0	38.4	---	--
91D*	2.941	2.733	24072	1.864	0.0	0.0	---	--
92D	1.288	0.999	11171	---	0.0	6.5	0.000	--
93D	1.024	0.864	11675	---	0.0	0.0	---	--
94D	0.843	0.678	10653	0.568	0.0	0.0	---	--
95D	3.200	3.109	206497	---	0.0	10.1	---	--
96D	0.229	0.197	2290	0.083	0.9	0.0	---	--
97D	0.190	0.162	1828	---	0.0	0.0	---	--
98D	0.219	0.155	1385	0.138	0.0	0.0	---	--
99D	0.828	0.674	17816	---	0.0	106.1	---	--
100D	0.212	0.176	2279	0.039	0.0	0.4	---	--
101D	0.221	0.186	2515	0.134	11.8	0.0	---	--
102D	1.118	0.621	24054	---	0.0	0.0	---	--
103D	0.674	0.503	6214	0.214	0.0	0.0	---	--
104D	0.293	0.278	4360	0.143	0.0	3.4	---	--
105D	1.245	1.349	40191	---	0.0	0.0	---	--
106D	0.947	0.876	13763	0.403	0.0	0.0	---	--
107D	0.884	0.764	0	---	0.0	4.6	---	--
108D	1.726	0.452	23880	0.740	0.0	0.0	---	--
109D	4.108	3.081	43295	---	33.3	832.6	---	--
110D	0.725	0.418	0	0.061	0.0	25.1	---	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 3

SAMP. NO.	PETRO #/MI	N-PAR #/MI	ASBESTOS FBRS/MI X10EXP-6	RUBBER #/MI	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
111D	0.619	0.513	7769	0.355	0.0	41.8	---	--
112D	1.002	0.901	34565	---	0.0	0.0	---	--
113D	0.265	0.236	9753	---	0.0	0.5	---	--
114D	0.273	0.237	17996	0.216	0.0	0.0	---	--
115D	0.181	0.153	0	0.116	0.0	4.5	---	--
116D	0.955	0.868	----	0.282	0.0	86.2	---	--
117D	1.594	1.594	----	---	0.0	6.6	---	--
118D	0.843	0.693	----	---	0.0	21.8	---	--
119D	2.873	1.892	----	---	0.0	0.0	---	--
120D	1.166	0.806	----	---	0.0	46.7	---	--
121D	0.951	0.894	----	---	0.0	0.0	---	--
122D	1.144	1.103	----	---	0.0	0.0	---	--
123D	0.334	0.173	----	---	7.3	56.9	---	--
124D	0.209	0.170	----	---	13.7	12.2	---	--
125D	0.458	0.349	----	---	3.5	201.0	---	--
126D	1.040	0.937	----	---	949.2	6882.2	---	--
127D	0.688	0.527	----	---	75.8	1880.8	---	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	PB 3	CR 4	CU 4	NI 4	ZN 4	CD 6	BA 4	HG 7	AG 4	SN 4	SB 4	SE 4	AS 4
1D	106	51	117	87	---	---	---	0	---	---	---	--	--
2D	8	6	51	34	---	166	27	0	103	5	27	0	0
3D	4	4	26	21	---	---	---	0	---	---	---	--	--
4D	1	3	33	23	---	---	---	0	---	---	---	--	--
5D	6	6	42	27	---	---	---	0	---	---	---	--	--
6D	1	4	36	23	---	---	---	8	---	---	---	--	--
7D	1186	150	603	493	7054	---	---	0	---	---	---	--	--
8D*	----	---	---	---	---	---	---	---	---	---	---	--	--
9D	141	18	216	142	2811	---	---	0	---	---	---	--	--
10D	119	16	110	228	2924	0	54	0	536	21	54	0	0
11D*	----	---	---	---	---	---	---	---	---	---	---	--	--
12D	201	14	65	156	2310	---	---	0	---	---	---	--	--
13D	799	59	233	213	3798	---	---	22	---	---	---	--	--
14D	735	53	147	115	2691	---	---	0	---	---	---	--	--
15D*	----	---	---	---	---	---	---	---	---	---	---	--	--
16D	1012	67	1459	411	4307	---	---	0	---	---	---	--	--
17D	1945	69	527	131	6909	---	---	0	---	---	---	--	--
18D*	----	---	---	---	---	---	---	---	---	---	---	--	--
19D	1224	48	178	144	2054	874	252	0	1372	69	252	0	0
20D	1391	99	405	218	4121	---	---	0	---	---	---	--	--
21D	5319	108	2995	283	5799	---	---	0	---	---	---	--	--
22D	4681	126	342	364	7692	---	---	0	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	PB 3	CR 4	CU 4	NI 4	ZN 4	CD 6	BA 4	HG 7	AG 4	SN 4	SB 4	SE 4	AS 4
23D	2694	64	219	245	5124	---	---	0	---	---	---	--	--
24D*	----	---	---	---	---	---	---	---	---	---	---	--	--
25D	6286	145	546	1080	6443	---	---	0	---	---	---	--	--
26D	2600	51	223	189	4280	1222	177	0	1238	124	177	0	0
27D	883	431	134	318	3125	---	---	0	---	---	---	--	--
28D	271	160	46	96	2131	271	42	0	421	35	42	0	0
29D	232	100	62	108	1416	---	---	0	---	---	---	--	--
30D*	----	---	---	---	---	---	---	---	---	---	---	--	--
31D	423	143	56	148	1334	---	---	0	---	---	---	--	--
32D	298	184	51	151	818	---	---	0	---	---	---	--	--
33D	2017	67	279	94	2017	---	297	---	---	---	---	--	--
34D	330	11	28	19	1678	153	19	39	1	18	19	0	0
35D	173	24	39	23	380	---	0	---	---	---	---	--	--
36D	112	38	23	41	431	80	---	---	---	---	---	--	--
37D	6367	196	710	398	6857	---	845	---	---	---	---	--	--
38D	853	34	1656	70	1342	903	122	75	46	0	122	0	20
39D	978	34	81	63	1401	---	12	---	---	---	---	--	--
40D	444	98	186	301	1925	378	---	---	---	---	---	--	--
41D	6514	1723	3072	2028	7459	5091	---	---	---	---	---	--	--
42D	5407	88	267	201	3801	---	305	---	---	---	---	--	--
43D	3007	76	503	213	3599	84786	174	0	12	0	174	0	0
44D	9568	257	1540	895	8635	---	895	---	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	PB 3	CR 4	CU 4	NI 4	ZN 4	CD 6	BA 4	HG 7	AG 4	SN 4	SB 4	SE 4	AS 4
45D	2355	77	143	238	1853	---	135	---	---	---	---	--	--
46D	5584	144	367	423	4268	---	383	---	---	---	---	--	--
47D	558	220	107	237	1183	---	0	---	---	---	---	--	--
48D	142	96	45	86	813	---	49	---	---	---	---	--	--
49D	541	118	163	140	1163	231	72	222	3	0	72	0	0
50D	76	47	16	35	539	---	21	---	---	---	---	--	--
51D	626	97	696	383	3675	---	125	---	---	---	---	--	--
52D	223	26	114	126	1200	---	0	---	---	---	---	--	--
53D	401	33	164	339	1642	252	190	0	0	0	190	0	0
54D	144	22	94	158	711	---	0	---	---	---	---	--	--
55D	106	10	20	68	392	---	0	---	---	---	---	--	--
56D	141	28	58	96	578	---	0	---	---	---	---	--	--
57D	222	10	40	54	1449	93	0	34	0	0	0	0	0
58D	148	8	1281	50	1212	---	31	---	---	---	---	--	--
59D	308	18	34	40	1110	---	0	---	---	---	---	--	--
60D	55	25	41	139	1347	185	---	---	---	---	---	--	--
61D	107	63	22	46	314	243	---	---	---	---	---	--	--
62D	151	87	68	247	1019	400	---	---	---	---	---	--	--
63D	90	15	11	14	99	55	---	---	---	---	---	--	--
64D	53	44	15	41	261	108	---	---	---	---	---	--	--
65D	66	19	12	24	257	138	---	---	---	---	---	--	--
66D	48	34	20	61	544	141	---	---	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP.	PB	CR	CU	NI	ZN	CD	BA	HG	AG	SN	SB	SE	AS
NO.	3	4	4	4	4	6	4	7	4	4	4	4	4
67D	4274	1459	1194	1227	6533	4974	---	---	---	---	---	--	--
68D	223	146	69	297	2099	414	---	---	---	---	---	--	--
69D	173	133	67	95	502	157	---	---	---	---	---	--	--
70D	162	102	40	96	565	157	---	---	---	---	---	--	--
71D	179	79	84	79	495	268	---	---	---	---	---	--	--
72D	153	75	68	133	500	210	---	---	---	---	---	--	--
73D	3884	998	355	969	2696	1460	---	---	---	---	---	--	--
74D	1064	555	118	656	1000	694	---	---	---	---	---	--	--
75D	1200	437	175	580	1282	716	---	---	---	---	---	--	--
76D	2202	577	134	570	1364	637	---	---	---	---	---	--	--
77D	1276	791	211	882	1798	828	---	---	---	---	---	--	--
78D	495	284	69	331	800	4	---	---	---	---	---	--	--
79D	65	38	54	80	401	94	---	---	---	---	---	--	--
80D	245	148	67	158	1249	197	---	---	---	---	---	--	--
81D*	----	---	---	---	---	---	---	---	---	---	---	--	--
82D	197	105	39	112	918	144	---	---	---	---	---	--	--
83D	56	22	18	33	603	77	---	---	---	---	---	--	--
84D	4306	1670	426	1277	3373	3275	---	---	---	---	---	--	--
85D	198	59	29	83	15	141	---	---	---	---	---	--	--
86D	254	90	41	152	507	107	---	---	---	---	---	--	--
87D*	----	---	---	---	---	---	---	---	---	---	---	--	--
88D	256	89	32	101	949	105	---	---	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	PB 3	CR 4	CU 4	NI 4	ZN 4	CD 6	BA 4	HG 7	AG 4	SN 4	SB 4	SE 4	AS 4
89D	123	36	23	35	755	46	---	---	---	---	---	--	--
90D	820	1505	423	1826	3450	6764	---	---	---	---	---	--	--
91D*	----	---	---	---	---	---	---	---	---	---	---	--	--
92D	169	217	94	333	671	0	---	---	---	---	---	--	--
93D	239	171	78	173	673	201	---	---	---	---	---	--	--
94D	121	222	126	236	392	0	---	---	---	---	---	--	--
95D	3455	542	480	613	2887	1777	---	---	---	---	---	--	--
96D	164	35	22	29	288	158	---	---	---	---	---	--	--
97D	63	8	5	10	59	47	---	---	---	---	---	--	--
98D	95	19	16	20	180	71	---	---	---	---	---	--	--
99D	366	136	83	155	682	307	---	---	---	---	---	--	--
100D	69	67	22	56	275	118	---	---	---	---	---	--	--
101D	58	88	80	53	207	130	---	---	---	---	---	--	--
102D	538	172	95	192	1138	414	---	---	---	---	---	--	--
103D	870	90	71	97	620	321	---	---	---	---	---	--	--
104D	237	55	125	67	359	150	---	---	---	---	---	--	--
105D	3631	481	128	543	2213	1037	---	---	---	---	---	--	--
106D	2416	379	121	379	1198	474	---	---	---	---	---	--	--
107D	1122	257	96	235	1073	402	---	---	---	---	---	--	--
108D	2576	448	173	990	9944	1232	---	---	---	---	---	--	--
109D	1849	403	213	301	2472	734	---	---	---	---	---	--	--
110D	204	101	56	82	570	491	---	---	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-2 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
DUST AND DIRT - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	PB 3	CR 4	CU 4	NI 4	ZN 4	CD 6	BA 4	HG 7	AG 4	SN 4	SB 4	SE 4	AS 4
111D	278	118	65	100	523	527	---	---	---	---	---	--	--
112D	2484	154	80	152	1188	401	---	---	---	---	---	--	--
113D	313	32	23	40	535	168	---	---	---	---	---	--	--
114D	236	65	19	37	467	257	---	---	---	---	---	--	--
115D	253	29	27	38	216	510	---	---	---	---	---	--	--
116D	197	254	126	189	267	651	---	---	---	---	---	--	--
117D	351	261	209	235	1771	1739	---	---	---	---	---	--	--
118D	230	185	50	85	736	107	---	---	---	---	---	--	--
119D	1531	596	434	575	2614	701	---	---	---	---	---	--	--
120D	586	178	115	190	1801	343	---	---	---	---	---	--	--
121D	393	173	405	179	175	380	---	---	---	---	---	--	--
122D	394	210	84	227	1719	204	---	---	---	---	---	--	--
123D	189	48	24	44	318	64	---	---	---	---	---	--	--
124D	151	21	20	28	295	65	---	---	---	---	---	--	--
125D	190	43	40	48	381	78	---	---	---	---	---	--	--
126D	493	82	66	101	1150	439	---	---	---	---	---	--	--
127D	269	59	47	59	1007	424	---	---	---	---	---	--	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN

TABLE C-3. POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
**1F	9.81	3.03	----	0.2111	1.733	0.018
**2F	1.29	0.46	----	0.0241	0.554	0.002
**3F	0.99	0.43	----	0.0345	0.425	0.006
**4F	0.58	0.18	----	0.0271	0.270	0.027
**5F	0.96	0.37	----	0.0526	0.537	0.022
**6F	0.61	0.31	----	0.0375	0.385	0.032
7F	10.39	2.05	9.90	0.2243	4.675	0.395
8F*	4.42	0.44	3.41	0.3287	2.363	0.207
9F	4.69	1.75	3.74	0.3742	2.355	0.229
10F	2.61	1.96	2.55	0.2172	1.397	0.112
11F*	2.01	1.72	1.79	0.1688	1.409	0.159
12F	5.00	3.18	4.18	0.3632	3.379	0.308
13F	6.72	3.62	5.61	0.5283	3.434	0.404
**14F	13.69	4.04	----	0.1401	1.732	0.333
**15F*	2.71	1.06	----	0.0360	0.790	0.119
**16F	16.71	3.38	----	0.1785	5.963	0.370
**17F	24.64	5.06	----	0.2541	9.037	0.876
**18F*	12.61	3.67	----	0.0980	6.914	0.381
**19F	17.22	3.49	----	0.4348	2.875	0.494
**20F	26.51	3.04	----	0.1366	2.214	0.702
21F	15.98	3.17	13.63	0.1772	1.803	0.535
22F	4.99	1.31	4.82	0.1233	1.867	0.212

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
23F	5.23	1.52	3.62	0.1320	2.372	0.175
24F*	7.61	1.19	5.42	0.2289	3.677	0.303
25F	3.48	1.24	2.21	0.1497	1.867	0.131
26F	8.05	2.90	5.62	0.3576	3.734	0.227
**27F	19.44	8.23	----	1.4193	11.811	1.145
**28F	5.28	2.99	----	0.2792	2.890	0.352
**29F	9.11	10.55	----	0.3294	5.287	0.406
**30F*	6.96	1.84	----	0.3764	1.511	0.197
**31F	8.37	3.08	----	0.3206	2.741	0.381
**32F	8.19	1.69	----	0.3085	2.214	0.281
33F	5.23	1.77	2.50	0.2201	1.269	0.182
34F	3.21	1.95	3.38	0.2128	1.460	0.266
35F	0.01	1.56	1.43	0.0954	0.312	0.088
36F	0.43	2.50	3.34	0.1981	1.108	0.197
**37F	45.77	6.10	----	0.7217	5.328	0.770
**38F	9.38	1.03	----	0.1492	1.322	0.172
**39F	8.18	1.29	----	0.2226	1.408	0.186
**40F	9.41	2.67	----	0.2018	2.020	0.235
**41F	63.87	9.36	----	1.0739	6.482	1.135
42F	13.40	5.31	8.08	0.1365	2.109	0.253
43F	9.48	5.43	8.83	0.1376	2.207	0.206
44F	12.51	4.49	6.71	0.1651	1.777	0.280

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
45F	29.87	8.85	5.29	0.2713	3.256	0.653
46F	7.91	6.85	5.87	0.3269	2.893	0.327
**47F	21.80	7.68	----	0.9439	6.757	1.249
**48F	4.78	1.82	----	0.2553	2.076	0.292
**49F	10.47	6.90	----	0.6292	6.590	0.450
**50F	2.66	1.25	----	0.1447	1.609	0.205
51F	20.30	8.82	21.99	0.9148	5.700	1.151
52F	16.15	6.87	15.09	0.6927	4.079	0.791
53F	8.76	4.97	10.82	0.5674	3.088	0.488
54F	15.68	4.87	15.93	0.8005	4.757	0.717
55F	8.45	3.37	5.77	0.6048	2.859	0.519
56F	9.80	1.75	11.56	0.3254	2.661	0.530
57F	4.80	0.61	2.01	0.1532	0.993	0.170
58F	1.81	0.49	2.11	0.1437	0.909	0.145
59F	4.52	1.21	4.63	0.3740	1.617	0.249
60F	2.16	0.60	2.22	0.2317	0.878	0.117
**61F	36.52	5.00	----	0.8570	6.811	1.332
**62F	7.52	1.87	----	0.1051	1.321	0.241
**63F	1.38	0.24	----	0.0277	0.203	0.048
**64F	2.02	0.65	----	0.0458	0.432	0.054
**65F	1.73	0.41	----	0.0393	0.338	0.064
**66F	3.53	0.98	----	0.1356	0.893	0.174

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
**67F	124.81	17.95	----	1.6414	13.959	2.178
**68F	7.78	1.34	----	0.1314	1.233	0.233
**69F	5.91	0.73	----	0.1139	0.942	0.171
**70F	5.91	0.91	----	0.1366	1.178	0.164
**71F	6.72	0.96	----	0.0964	0.958	0.134
**72F	7.91	1.73	----	0.1359	1.203	0.217
73F	17.15	1.61	17.44	0.1541	2.817	0.044
74F	16.86	2.09	14.06	0.1541	2.273	0.033
75F	7.04	0.33	8.25	0.1651	2.229	0.020
76F	2.31	1.80	1.23	0.0154	0.248	0.003
77F	7.80	1.30	7.43	0.0825	1.546	0.025
78F	27.27	4.06	22.45	0.3170	1.840	0.414
79F	22.10	2.61	21.30	0.3043	3.499	0.888
80F	7.83	1.25	6.68	0.2747	2.626	0.380
**81F*	26.61	2.98	----	0.6223	5.885	1.012
82F	10.51	1.49	10.81	0.3663	1.585	0.587
83F	14.33	1.34	15.63	0.3156	2.485	1.560
84F	9.39	1.47	6.50	0.0687	0.588	0.243
85F	14.82	1.09	7.40	0.0986	2.643	0.394
86F	3.45	0.38	2.76	0.0345	0.392	0.111
**87F*	20.87	3.61	----	0.6237	3.469	0.592
88F	4.92	0.71	5.53	0.1690	0.757	0.169

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
89F	1.76	0.34	1.18	0.0338	0.437	0.167
90F	113.14	12.16	116.81	0.4587	11.993	2.294
91F*	45.31	3.83	28.83	0.1614	2.362	0.789
92F	4.09	0.81	5.06	0.0880	0.741	0.230
93F	6.67	1.24	7.75	0.1320	1.730	0.356
94F	6.39	1.18	6.85	0.1272	1.604	0.270
95F	39.23	6.42	36.66	0.1612	1.090	1.080
96F	8.70	1.36	8.39	0.1679	1.231	0.343
97F	11.01	1.25	11.88	0.3134	1.319	0.355
98F	1.62	0.18	2.28	0.0851	0.246	0.074
99F	23.94	1.80	16.76	0.1908	1.321	0.264
100F	8.59	1.92	9.62	0.2300	1.701	1.673
101F	4.21	0.87	3.58	0.0954	0.439	0.104
**102F	15.58	1.77	----	0.2072	2.030	0.335
**103F	8.05	0.97	----	0.1203	1.371	0.213
**104F	5.65	0.81	----	0.0919	0.947	0.127
105F	27.51	1.66	29.32	0.1981	2.945	0.555
106F	9.72	1.16	10.24	0.1733	0.982	0.182
107F	14.66	3.32	11.06	0.2146	2.988	0.304
108F	13.65	2.09	13.22	0.1288	2.159	0.307
109F	4.78	1.57	3.52	0.0634	1.039	0.085
110F	10.95	1.05	6.56	0.1648	1.059	0.273

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 1

SAMP. NO.	TOTAL SOLIDS #/MI	TOTAL VOLATILE SOLIDS #/MI	SUSPENDED SOLIDS #/MI	BOD #/MI	COD #/MI	GREASE #/MI
111F	5.49	1.18	4.94	0.1620	1.952	0.275
112F	34.64	4.37	29.99	0.2835	4.775	0.679
113F	3.19	0.70	2.84	0.0716	1.236	0.184
114F	4.42	0.72	3.26	0.1347	2.835	0.191
115F	2.27	0.54	1.79	0.0582	1.025	0.118
116F	18.76	3.62	14.50	0.2811	5.376	0.759
117F	13.29	2.45	12.51	0.1687	3.476	0.440
118F	5.27	1.81	4.22	0.1476	1.517	0.312
119F	11.22	2.40	8.98	0.1113	3.027	0.456
120F	5.88	1.70	4.48	0.0316	2.193	0.358
121F	7.10	1.85	7.52	0.1195	3.465	0.378
122F	3.07	0.96	2.29	0.0498	1.145	0.189
123F	0.86	0.12	0.76	0.0282	0.637	0.068
124F	6.84	0.98	6.90	0.0852	2.998	0.256
125F	6.69	2.56	3.56	0.1007	1.348	0.248
126F	3.91	1.02	3.34	0.4480	2.054	0.203
127F	5.25	1.61	2.56	0.4670	3.251	0.223

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
**1F	0.476	0.078	0.209	0.614	0.093	0.006
**2F	0.119	0.029	0.016	0.453	0.023	0.002
**3F	0.050	0.018	0.024	0.485	0.020	0.002
**4F	0.017	0.011	0.016	0.097	0.007	0.001
**5F	0.050	0.005	0.076	0.323	0.023	0.002
**6F	0.025	0.019	0.024	0.517	0.012	0.001
7F	0.350	0.013	0.720	0.078	0.073	0.020
8F*	0.175	0.021	0.801	0.165	0.031	0.031
9F	0.165	0.011	0.616	0.207	0.044	0.077
10F	0.070	0.000	1.403	0.154	0.029	0.053
11F*	0.088	0.015	2.047	0.086	0.029	0.066
12F	0.187	0.022	0.605	0.183	0.044	0.088
13F	0.132	0.013	2.034	0.135	0.053	0.026
**14F	1.268	0.027	0.105	0.000	0.021	0.014
**15F*	0.165	0.000	0.053	0.032	0.017	0.005
**16F	1.512	0.017	0.085	0.582	0.049	0.035
**17F	1.294	0.049	0.416	0.065	0.076	0.047
**18F*	1.644	0.013	0.098	0.162	0.037	0.037
**19F	0.868	0.017	0.096	0.065	0.033	0.036
**20F	1.367	0.000	0.416	0.032	0.066	0.037
21F	0.385	0.008	1.248	0.243	0.039	0.092
22F	0.128	0.000	0.880	0.066	0.026	0.101

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
23F	0.149	0.006	1.222	0.185	0.033	0.110
24F*	0.229	0.043	1.550	0.288	0.029	0.058
25F	0.092	0.004	1.413	0.278	0.013	0.145
26F	0.179	0.029	2.404	0.437	0.029	0.200
**27F	0.966	0.019	0.701	0.032	0.032	0.054
**28F	0.249	0.042	0.436	0.000	0.036	0.015
**29F	0.493	0.183	0.465	0.000	0.107	0.019
**30F*	----	----	----	----	0.011	0.008
**31F	0.294	0.193	0.752	0.000	0.013	0.017
**32F	0.305	0.345	0.559	0.000	0.012	0.030
33F	0.836	0.010	1.013	0.039	0.000	0.476
34F	0.352	0.015	1.564	0.032	0.000	0.326
35F	0.062	0.000	0.083	0.022	0.010	0.103
36F	0.147	0.000	0.927	0.052	0.020	0.089
**37F	1.627	0.664	1.418	0.000	0.024	0.111
**38F	0.388	0.408	0.679	0.000	0.005	0.017
**39F	0.003	0.006	0.162	0.032	0.013	0.024
**40F	0.003	0.000	0.258	0.032	0.014	0.017
**41F	3.386	0.000	----	0.226	0.175	0.909
42F	0.881	0.000	0.001	0.089	0.035	0.150
43F	0.903	0.006	1.018	0.083	0.014	0.204
44F	0.836	0.006	1.139	0.134	0.014	0.160

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P	PO4-P	NO3-N	NO2-N	KJELD. N	CL
	2	2	2	2	0	0
45F	1.085	0.009	0.847	0.227	0.066	0.103
46F	1.114	0.036	2.146	0.243	0.048	0.242
**47F	0.745	0.459	1.371	0.032	0.190	0.051
**48F	0.167	0.153	0.405	0.000	0.033	0.010
**49F	0.270	0.535	1.093	0.032	0.075	0.035
**50F	0.100	0.045	0.220	0.032	0.013	0.006
51F	1.267	0.035	0.845	0.113	0.106	0.088
52F	0.724	0.031	0.785	0.143	0.062	0.123
53F	1.372	0.026	0.066	0.040	0.132	0.198
54F	0.647	0.077	0.262	0.045	0.046	0.078
55F	0.396	0.011	0.121	0.055	0.033	0.033
56F	0.453	0.023	0.488	0.020	0.012	0.163
57F	0.201	0.169	0.428	0.009	0.000	0.074
58F	0.165	0.017	0.317	0.009	0.004	0.059
59F	0.247	0.019	0.495	0.011	0.038	0.121
60F	0.118	0.020	0.454	0.009	0.005	0.069
**61F	2.295	0.000	1.351	0.226	0.177	0.077
**62F	0.365	0.000	0.643	0.000	0.029	0.023
**63F	0.091	0.000	0.091	0.000	0.006	0.069
**64F	0.131	0.000	0.149	0.000	0.009	0.068
**65F	0.120	0.004	0.129	0.000	0.003	0.040
**66F	0.288	0.039	0.187	0.032	0.004	0.147

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P 2	PO4-P 2	NO3-N 2	NO2-N 2	KJELD. N 0	CL 0
**67F	6.057	0.000	1.625	0.097	0.417	0.175
**68F	0.418	0.000	0.543	0.097	0.023	0.032
**69F	0.329	0.000	0.198	0.065	0.014	0.043
**70F	0.305	0.000	0.227	0.065	0.013	0.097
**71F	0.366	0.000	0.178	0.032	0.015	0.054
**72F	0.419	0.000	0.485	0.097	0.013	0.091
73F	0.594	0.011	1.728	0.122	0.000	0.110
74F	0.532	0.023	1.425	0.143	0.000	0.008
75F	0.347	0.017	1.271	0.144	0.000	0.018
76F	0.041	0.002	0.102	0.014	0.001	0.000
77F	0.198	0.006	0.556	0.105	0.017	0.021
78F	0.546	0.009	0.264	0.053	0.018	0.000
79F	0.862	0.203	0.697	0.047	0.051	0.000
80F	0.470	0.005	0.507	0.037	0.021	0.011
**81F*	----	----	----	----	----	0.026
82F	0.662	0.141	1.620	0.031	0.035	0.035
83F	0.592	0.020	1.824	0.013	0.128	0.002
84F	0.255	0.007	0.030	0.025	0.004	0.000
85F	0.355	0.020	0.621	0.061	0.039	0.000
86F	0.113	0.005	0.106	0.019	0.009	0.001
**87F*	----	----	----	----	----	0.029
88F	0.275	0.025	1.933	0.019	0.035	0.006

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P	PO4-P	NO3-N	NO2-N	KJELD. N	CL
	2	2	2	2	0	0
89F	0.127	0.006	0.561	0.008	0.009	0.004
90F	3.080	0.098	4.850	0.134	0.131	0.000
91F*	0.704	0.044	3.873	0.073	0.044	0.000
92F	0.330	0.044	1.357	0.049	0.015	0.000
93F	0.068	0.039	1.731	0.075	0.026	0.000
94F	0.423	0.108	1.514	0.103	0.029	0.001
95F	4.989	0.034	1.753	0.140	0.121	0.410
96F	3.180	0.009	1.156	0.083	0.065	0.131
97F	5.562	0.039	1.515	0.046	0.052	0.078
98F	1.365	0.004	0.622	0.069	0.013	0.013
99F	0.675	0.007	0.462	0.064	0.022	0.000
100F	0.544	0.007	1.178	0.117	0.028	0.000
101F	0.286	0.052	0.591	0.056	0.019	0.000
**102F	0.793	0.000	0.534	0.000	0.033	0.025
**103F	0.372	0.000	1.476	0.032	0.023	0.013
**104F	0.380	0.063	1.260	0.000	0.029	0.018
105F	1.572	0.000	1.426	0.203	0.040	0.000
106F	0.545	0.025	0.867	0.076	0.017	0.000
107F	1.090	0.182	2.922	0.244	0.033	0.066
108F	0.535	0.059	1.228	0.265	0.030	0.005
109F	0.363	0.035	0.285	0.017	0.018	0.010
110F	0.380	0.013	0.380	0.034	0.025	0.000

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 2

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	TOTAL PO4-P	PO4-P	NO3-N	NO2-N	KJELD. N	CL
	2	2	2	2	0	0
111F	0.437	0.032	0.632	0.028	0.024	0.000
112F	1.589	0.007	0.298	0.178	0.075	0.067
113F	0.389	0.004	0.475	0.143	0.031	0.031
114F	0.425	0.007	1.113	0.162	0.035	0.106
115F	0.336	0.004	0.555	0.099	0.018	0.036
116F	1.669	0.018	1.423	0.192	0.070	0.035
117F	0.946	0.047	0.871	0.192	0.047	0.019
118F	0.394	0.016	0.828	0.069	0.033	0.016
119F	0.545	0.033	1.714	0.171	0.056	0.067
120F	0.200	0.032	1.335	0.121	0.021	0.063
121F	0.199	0.020	1.085	0.044	0.030	0.040
122F	0.239	0.010	0.627	0.075	0.030	0.060
123F	0.017	0.023	0.136	0.015	0.011	0.006
124F	0.395	0.015	0.372	0.042	0.023	0.023
125F	0.302	0.023	0.232	0.057	0.023	0.062
126F	0.406	0.034	0.660	0.056	0.025	0.076
127F	0.440	0.055	0.018	0.080	0.027	0.073

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
**1F	0.012	0.000	0.0	0.0	0.0	---	----
**2F	0.001	0.000	1149.5	0.0	0.0	---	----
**3F	0.002	0.000	0.0	0.0	0.0	---	----
**4F	0.010	0.008	57.1	0.0	0.0	---	----
**5F	0.006	0.005	111.9	0.0	0.0	---	----
**6F	0.013	0.009	27.6	----	0.0	---	----
7F	0.218	0.198	0.0	135.0	0.0	0.000	0.00
8F*	0.154	0.131	---	8.9	0.0	0.000	0.00
9F	0.156	0.132	15.0	43.0	0.0	0.000	0.00
10F	0.081	0.065	42.6	11.5	0.0	0.000	0.00
11F*	0.090	0.067	33.3	14.7	0.0	0.000	0.00
12F	0.161	0.154	15.0	44.5	1.0	0.000	0.00
13F	0.156	0.106	30.0	41.4	2.1	0.000	0.00
**14F	0.141	0.124	863.5	0.0	0.0	---	----
**15F*	0.061	0.042	---	5.1	0.0	---	----
**16F	0.167	0.156	0.0	110.8	0.0	---	----
**17F	0.230	0.200	222.2	0.0	0.0	---	----
**18F*	0.169	0.157	---	0.0	0.0	---	----
**19F	0.220	0.198	621.5	0.0	0.0	---	----
**20F	0.256	0.231	0.0	76.0	31.4	---	----
21F	0.233	0.188	90.9	0.0	0.0	0.000	0.00
22F	0.085	0.057	52.0	1.0	0.0	0.000	0.00

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
23F	0.099	0.058	132.4	4.2	0.2	0.000	0.00
24F*	0.186	0.149	---	0.6	0.0	0.000	0.00
25F	0.094	0.053	52.0	0.0	0.0	0.000	0.00
26F	0.129	0.076	84.4	0.0	0.0	0.000	0.00
**27F	0.376	0.297	0.0	0.0	50.6	---	----
**28F	0.117	0.095	0.0	0.0	21.2	---	----
**29F	0.148	0.116	394.0	0.0	19.6	---	----
**30F*	0.191	0.163	50.2	0.0	54.2	---	----
**31F	0.154	0.133	0.0	0.0	25.9	---	----
**32F	0.135	0.074	59.0	0.0	94.3	---	----
33F	0.039	0.030	29.7	108.3	58.3	---	----
34F	0.079	0.036	13.7	137.2	1.6	---	----
35F	0.026	0.025	14.8	86.6	1.7	---	----
36F	0.067	0.036	6.8	8.3	10.0	---	----
**37F	0.266	0.216	2076.7	0.0	79.0	---	----
**38F	0.075	0.062	425.6	0.0	0.3	---	----
**39F	0.081	0.068	222.8	0.0	0.2	---	----
**40F	0.093	0.079	256.3	0.0	0.0	---	----
**41F	0.756	0.438	29359.7	0.0	938.4	---	----
42F	0.105	0.094	101.9	0.1	3.6	---	----
43F	0.115	0.077	70.0	1.5	1.6	---	----
44F	0.095	0.037	52.5	2.5	0.8	---	----

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
45F	0.346	0.262	76.5	0.4	0.9	---	----
46F	0.232	0.228	494.7	5.2	7.7	---	----
**47F	0.441	0.414	8843.3	0.0	289.3	---	----
**48F	0.106	0.009	1078.0	0.0	21.5	---	----
**49F	0.196	0.137	1793.1	0.0	32.3	---	----
**50F	0.070	0.050	909.9	0.0	8.8	---	----
51F	0.549	0.472	0.0	8.4	8.8	0.000	----
52F	0.520	0.345	0.1	12.9	5.3	---	----
53F	0.557	0.406	265.8	0.0	16.2	---	----
54F	0.311	0.228	0.0	0.0	5.3	---	----
55F	0.260	0.220	65.0	27.5	15.2	---	----
56F	0.298	0.126	2691.0	15.0	5.5	0.000	----
57F	0.136	0.069	551.6	4.4	1.2	---	----
58F	0.069	0.055	249.4	2.7	0.6	---	----
59F	0.165	0.088	748.3	2.0	6.9	---	----
60F	0.034	0.022	0.0	2.8	6.6	---	----
**61F	0.854	0.683	1975.1	0.0	34.7	---	----
**62F	0.160	0.073	881.5	0.0	100.7	---	----
**63F	0.036	0.031	0.0	0.0	0.2	---	----
**64F	0.049	0.036	474.4	0.0	29.8	---	----
**65F	0.049	0.034	593.1	0.0	1.0	---	----
**66F	0.105	0.102	413.9	0.0	9.2	---	----

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
**67F	1.361	0.700	0.0	0.0	59.2	---	----
**68F	0.145	0.112	0.0	0.0	1.9	---	----
**69F	0.099	0.081	1384.0	0.0	2.1	---	----
**70F	0.083	0.074	0.0	0.0	0.7	---	----
**71F	0.092	0.063	0.0	0.0	9.6	---	----
**72F	0.153	0.136	926.9	0.0	0.0	---	----
73F	0.172	0.154	0.0	4.8	0.4	---	----
74F	0.160	0.134	909.4	0.0	1.9	---	----
75F	0.130	0.071	0.0	0.0	0.0	---	----
76F	0.025	0.010	0.0	0.0	0.0	---	----
77F	0.132	0.118	649.6	0.0	0.3	---	----
78F	0.366	0.169	0.0	0.0	7.6	---	----
79F	0.488	0.312	1496.6	139.0	7.8	---	----
80F	0.190	0.119	0.0	0.0	0.1	0.000	----
**81F*	0.622	0.589	---	----	---	---	----
82F	0.333	0.251	0.0	0.0	0.0	---	----
83F	0.600	0.538	0.0	0.0	0.0	---	----
84F	0.112	0.104	0.0	15.1	3.7	---	----
85F	0.231	0.199	0.0	0.0	80.4	---	----
86F	0.050	0.043	163.1	0.0	0.0	0.000	----
**87F*	0.390	0.293	---	----	---	---	----
88F	0.085	0.081	0.0	0.0	0.5	---	----

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
89F	0.112	0.089	166.3	0.0	0.0	---	----
90F	1.180	1.055	9521.4	0.0	0.0	---	----
91F*	0.349	0.311	0.0	0.0	0.0	---	----
92F	0.153	0.092	0.0	0.0	0.0	0.000	----
93F	0.146	0.095	0.0	0.0	0.0	---	----
94F	0.090	0.080	0.0	0.0	0.0	---	----
95F	0.580	0.561	1555.9	0.0	6.1	---	----
96F	0.138	0.067	1101.0	26.5	8.3	---	----
97F	0.311	0.180	770.7	6521.0	0.0	---	----
98F	0.038	0.037	0.0	3.4	30.2	---	----
99F	0.197	0.128	0.0	18321.0	1.8	---	----
100F	0.149	0.142	0.0	0.5	1.4	---	----
101F	0.030	0.058	0.0	68.1	0.0	---	----
**102F	0.262	0.146	3594.3	0.0	0.0	---	----
**103F	0.158	0.118	928.5	0.0	0.0	---	----
**104F	0.069	0.065	651.5	0.0	2.7	---	----
105F	0.277	0.277	3070.0	188.9	20.4	---	----
106F	0.083	0.061	959.0	0.0	0.9	---	----
107F	0.165	0.149	0.0	0.7	2.6	---	----
108F	0.170	0.099	1151.0	0.0	51.7	---	----
109F	0.058	0.048	0.0	0.9	28.8	---	----
110F	0.117	0.066	748.0	7.6	19.4	---	----

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 3

SAMP. NO.	PETRO. #/MI	N-PAR. #/MI	ASBESTOS FBRS/MI X10EXP-6	FECAL COLIFORM ORG./MI X10EXP-6	FECAL STREP ORG./MI X10EXP-6	CN #/MI	CR+6 #/MI X10EXP+2
111F	0.122	0.122	0.0	1.3	5.1	---	----
112F	0.381	0.201	1728.0	0.0	4.2	---	----
113F	0.090	0.094	264.0	0.0	0.5	---	----
114F	0.113	0.106	0.0	0.8	1.0	---	----
115F	0.090	0.067	264.0	1361.8	57.0	---	----
116F	0.334	0.334	---	0.0	56.6	---	----
117F	0.169	0.221	---	0.0	23.4	---	----
118F	0.139	0.139	---	0.0	27.5	---	----
119F	0.223	0.134	---	0.0	0.0	---	----
120F	0.127	0.137	---	1.4	29.0	---	----
121F	0.209	0.169	---	4520.2	15.1	---	----
122F	0.100	0.070	---	784.3	109.8	---	----
123F	0.062	0.041	---	1.8	13.2	---	----
124F	0.132	0.116	---	193.5	17.6	---	----
125F	0.124	0.116	---	2233.7	212.8	---	----
126F	0.101	0.093	---	17.3	126.6	---	----
127F	0.110	0.110	---	14.6	1455.4	---	----

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
**1F	4	10	6	5	--	--
**2F	0	1	3	2	--	--
**3F	0	1	1	1	--	--
**4F	0	1	2	1	--	--
**5F	0	1	2	1	--	--
**6F	0	1	2	1	--	--
7F	69	7	19	23	112	0
8F*	--	--	--	--	--	--
9F	6	11	8	8	46	0
10F	6	6	4	5	35	1174
11F*	--	--	--	--	--	--
12F	16	11	11	13	115	1101
13F	15	13	12	13	62	0
**14F	31	11	8	6	55	--
**15F*	--	--	--	--	--	--
**16F	42	14	77	22	88	--
**17F	81	14	28	7	141	--
**18F*	--	--	--	--	--	--
**19F	51	10	9	8	42	--
**20F	58	20	21	11	84	--
21F	262	15	20	25	228	0
22F	95	4	7	12	76	0

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE * 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
23F	77	6	8	11	61	550
24F*	--	--	--	--	--	--
25F	37	5	8	7	41	0
26F	57	7	16	13	58	0
**27F	37	88	7	17	64	--
**28F	11	33	2	5	43	--
**29F	10	20	3	6	29	--
**30F*	--	--	--	--	--	--
**31F	18	29	3	8	27	--
**32F	12	36	3	8	17	--
**33F	64	14	15	5	41	--
**34F	14	2	1	1	34	--
**35F	7	5	2	1	8	--
**36F	5	8	1	2	9	--
**37F	265	40	37	21	140	--
**38F	36	7	87	4	27	--
**39F	41	7	4	3	29	--
**40F	19	20	10	16	39	--
**41F	271	353	162	107	152	--
**42F	225	18	14	11	78	--
**43F	125	16	26	11	73	--
**44F	399	53	81	47	176	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
**45F	98	16	8	13	38	--
**46F	233	29	19	22	87	--
**47F	23	45	6	12	24	--
**48F	6	20	2	5	17	--
**49F	23	24	9	7	24	--
**50F	3	10	1	2	11	--
**51F	26	20	37	20	75	--
**52F	9	5	6	7	24	--
**53F	17	7	9	18	34	--
**54F	6	5	5	8	15	--
**55F	4	2	1	4	8	--
**56F	6	6	3	5	12	--
**57F	9	2	2	3	30	--
**58F	6	2	67	3	25	--
**59F	13	4	2	2	23	--
**60F	2	5	2	7	27	--
**61F	4	13	1	2	6	--
**62F	6	18	4	13	21	--
**63F	4	3	1	1	2	--
**64F	2	9	1	2	5	--
**65F	3	4	1	1	5	--
**66F	2	7	1	3	11	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
**67F	178	299	63	64	133	--
**68F	9	30	4	16	43	--
**69F	7	27	4	5	10	--
**70F	7	21	2	5	12	--
**71F	7	16	4	4	10	--
**72F	6	15	4	7	10	--
**73F	162	204	19	51	55	--
**74F	44	114	6	35	20	--
**75F	50	90	9	31	26	--
**76F	92	118	7	30	28	--
**77F	53	162	11	46	37	--
**78F	21	58	4	17	16	--
**79F	3	8	3	4	8	--
**80F	10	30	4	8	25	--
**81F*	--	--	--	--	--	--
**82F	8	22	2	6	19	--
**83F	2	5	1	2	12	--
**84F	179	342	22	67	69	--
**85F	8	12	2	4	13	--
**86F	11	18	2	8	10	--
**87F*	--	--	--	--	--	--
**88F	11	18	2	5	19	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
**89F	5	7	1	2	15	--
**90F	34	308	22	96	70	--
**91F*	--	--	--	--	--	--
**92F	7	44	5	18	14	--
**93F	10	35	4	9	14	--
**94F	5	45	7	12	8	--
**95F	144	111	25	32	59	--
**96F	7	7	1	2	6	--
**97F	3	2	0	1	1	--
**98F	4	4	1	1	4	--
**99F	15	28	4	8	14	--
**100F	3	14	1	3	6	--
**101F	2	18	4	3	4	--
**102F	22	35	5	10	23	--
**103F	36	18	4	5	13	--
**104F	10	11	7	4	7	--
**105F	151	99	7	29	45	--
**106F	101	78	6	20	24	--
**107F	47	53	5	12	22	--
**108F	107	92	9	52	203	--
**109F	77	83	11	16	50	--
**110F	9	21	3	4	12	--

* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

TABLE C-3 (CONTINUED). POLLUTANT LOADS ON ROADWAYS
FLUSH - PART 4

#/MILE X 10 TO THE EXPONENT SHOWN

SAMP. NO.	LEAD 3	CHROMIUM 4	COPPER 4	NICKEL 4	ZINC 4	MERCURY 7
**111F	12	24	3	5	11	--
**112F	104	32	4	8	24	--
**113F	13	7	1	2	11	--
**114F	10	13	1	2	10	--
**115F	11	6	1	2	4	--
**116F	8	52	7	10	5	--
**117F	15	53	11	12	36	--
**118F	10	38	3	4	15	--
**119F	64	122	23	30	53	--
**120F	24	36	6	10	37	--
**121F	16	35	21	9	4	--
**122F	16	43	4	12	35	--
**123F	8	10	1	2	6	--
**124F	6	4	1	2	6	--
**125F	8	9	2	3	8	--
**126F	21	17	3	5	23	--
**127F	11	12	2	4	21	--

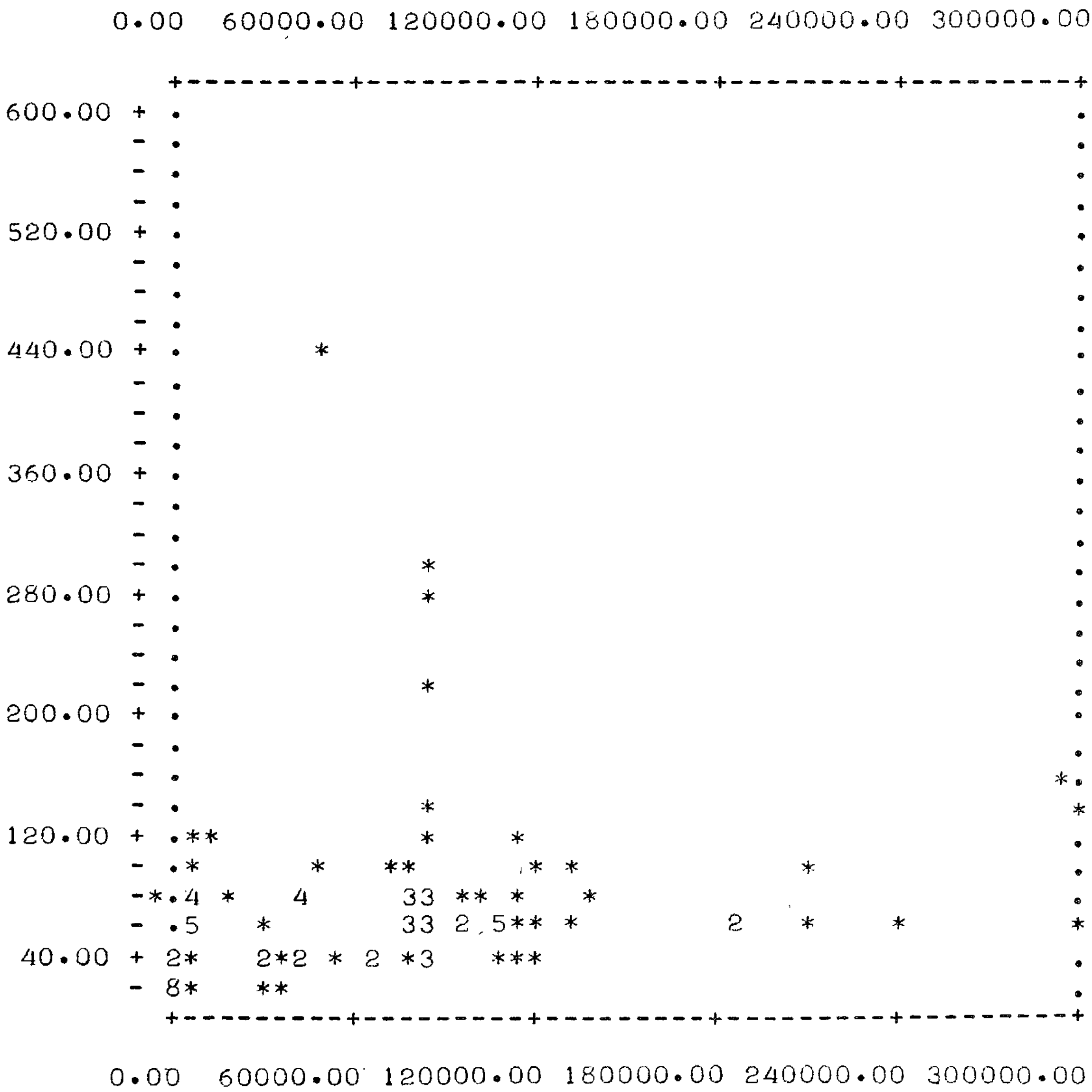
* INDICATED SAMPLES COLLECTED FOLLOWING RAIN
** INDICATED SAMPLES ARE CALCULATED VALUES

APPENDIX D

STATISTICAL ANALYSES AND PLOTS OF SAMPLE DATA

LITTER

DRYWTLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



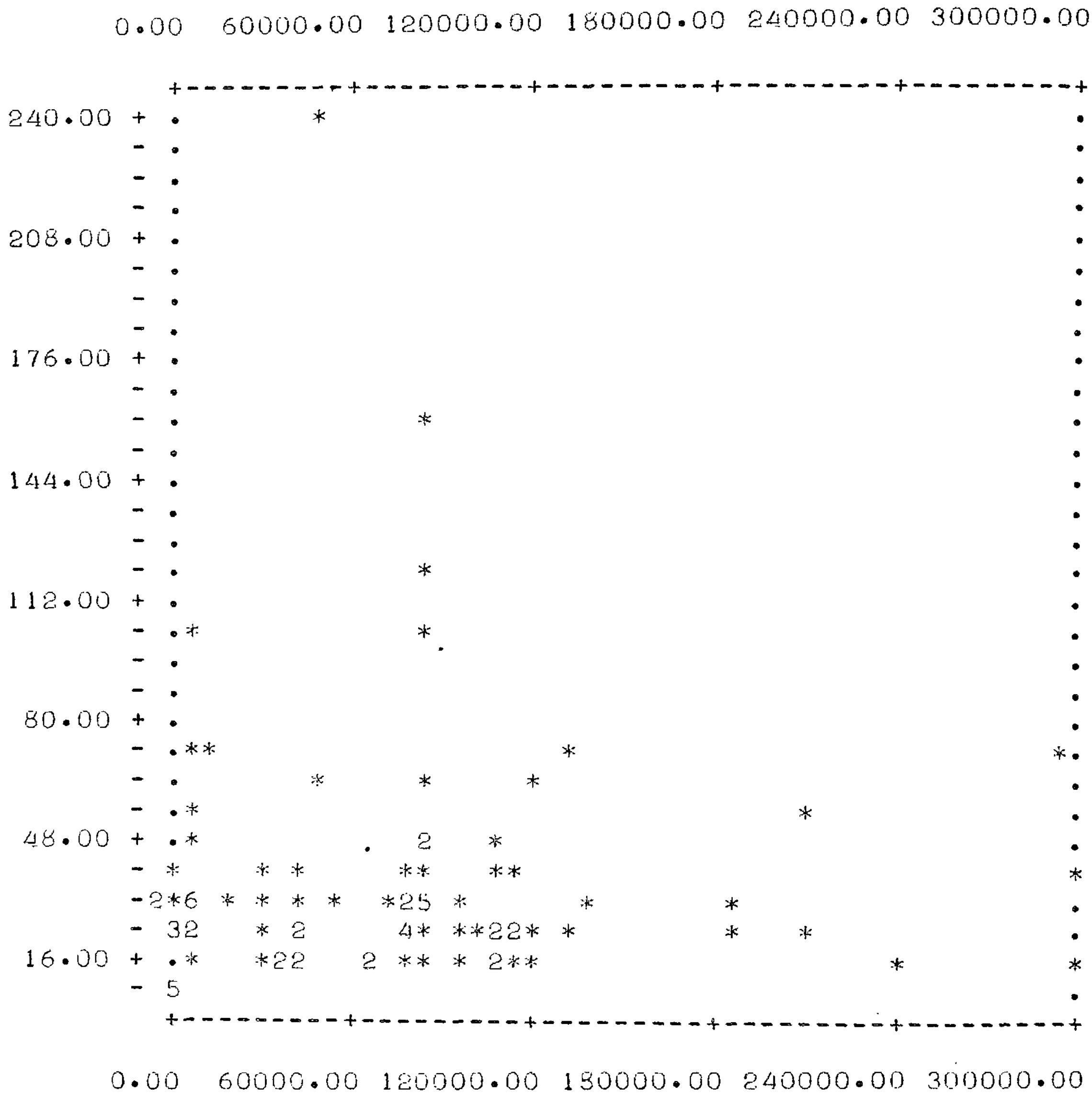
LB/MILE = 43.9218710000 + 0.0001689014 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.182

T= 1.7655

N= 93

VOLUMFLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 28.5667700000 + 0.0000172165 X XVALUE

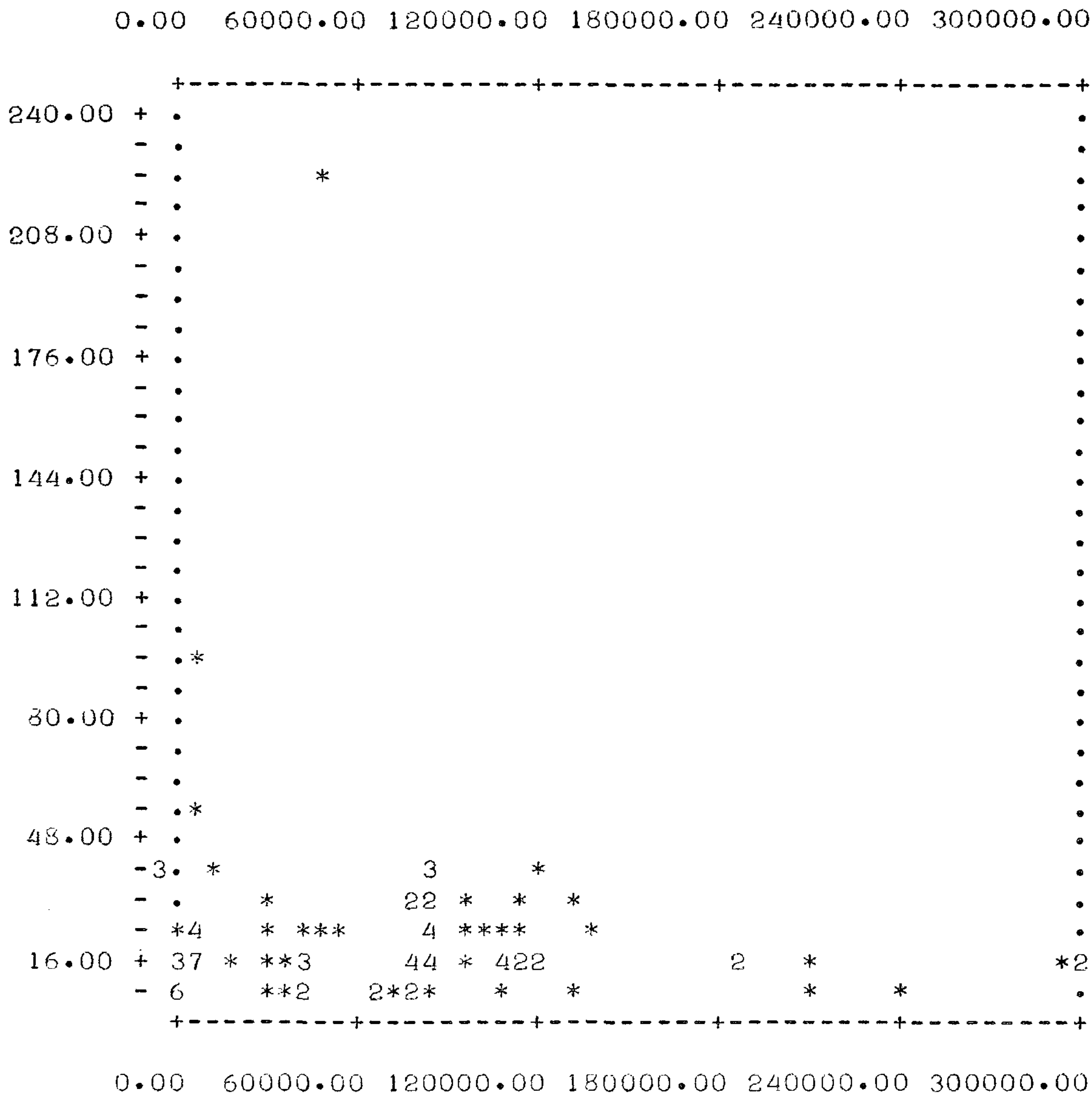
LINEAR CORRELATION COEFFICIENT= 0.035

T= 0.3306

N= 93

LITTER

VOLSLDSLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILF = 16.4911500000 + -0.0000264206 X XVALUE

LINEAR CORRELATION COEFFICIENT=-0.070

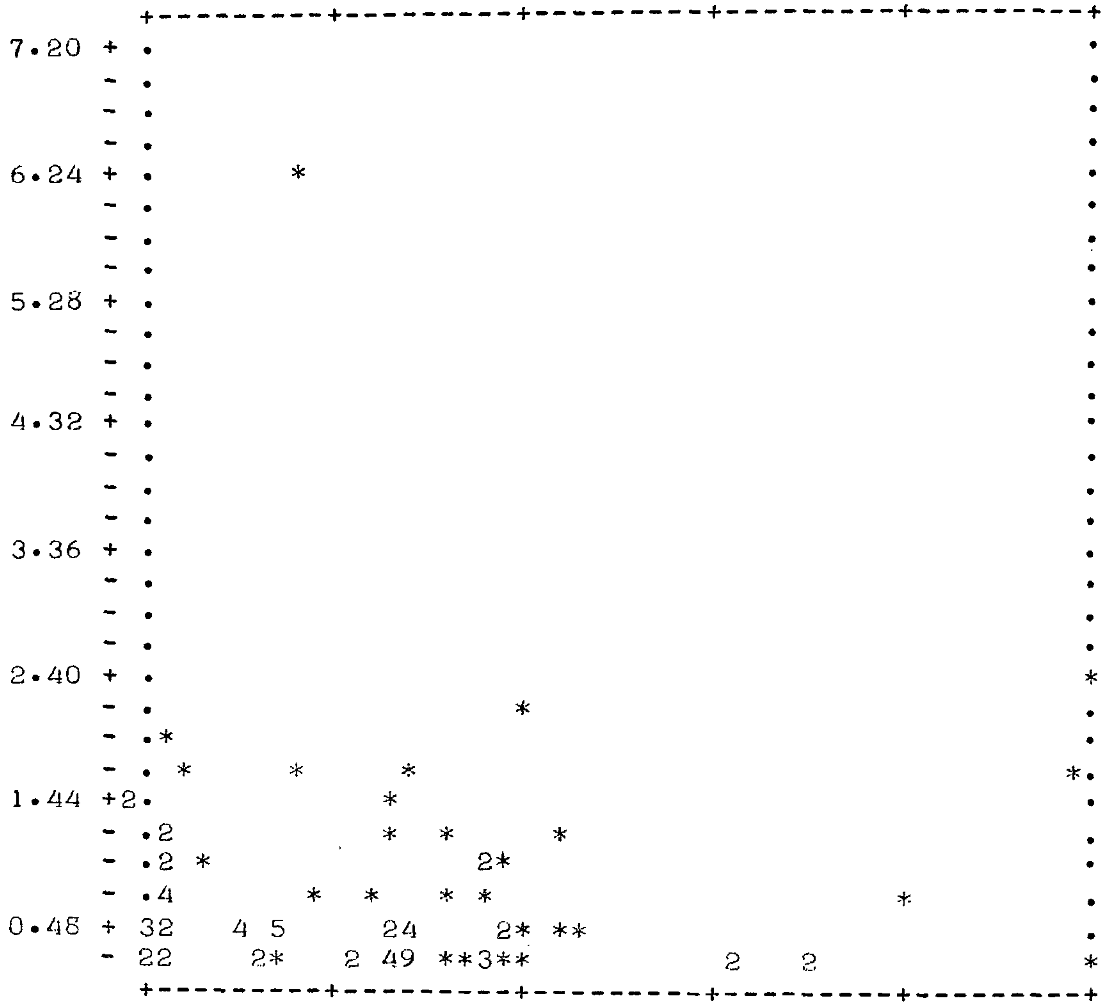
T= -0.6729

N= 93

LITTER

BODLOAD (VERT) VS. AXLES (HORZ)
LB/MILE

0.00 60000.00 120000.00 180000.00 240000.00 300000.00



0.00 60000.00 120000.00 180000.00 240000.00 300000.00

LB/MILE = 0.4332856200 + 0.0000003489 X XVALUE

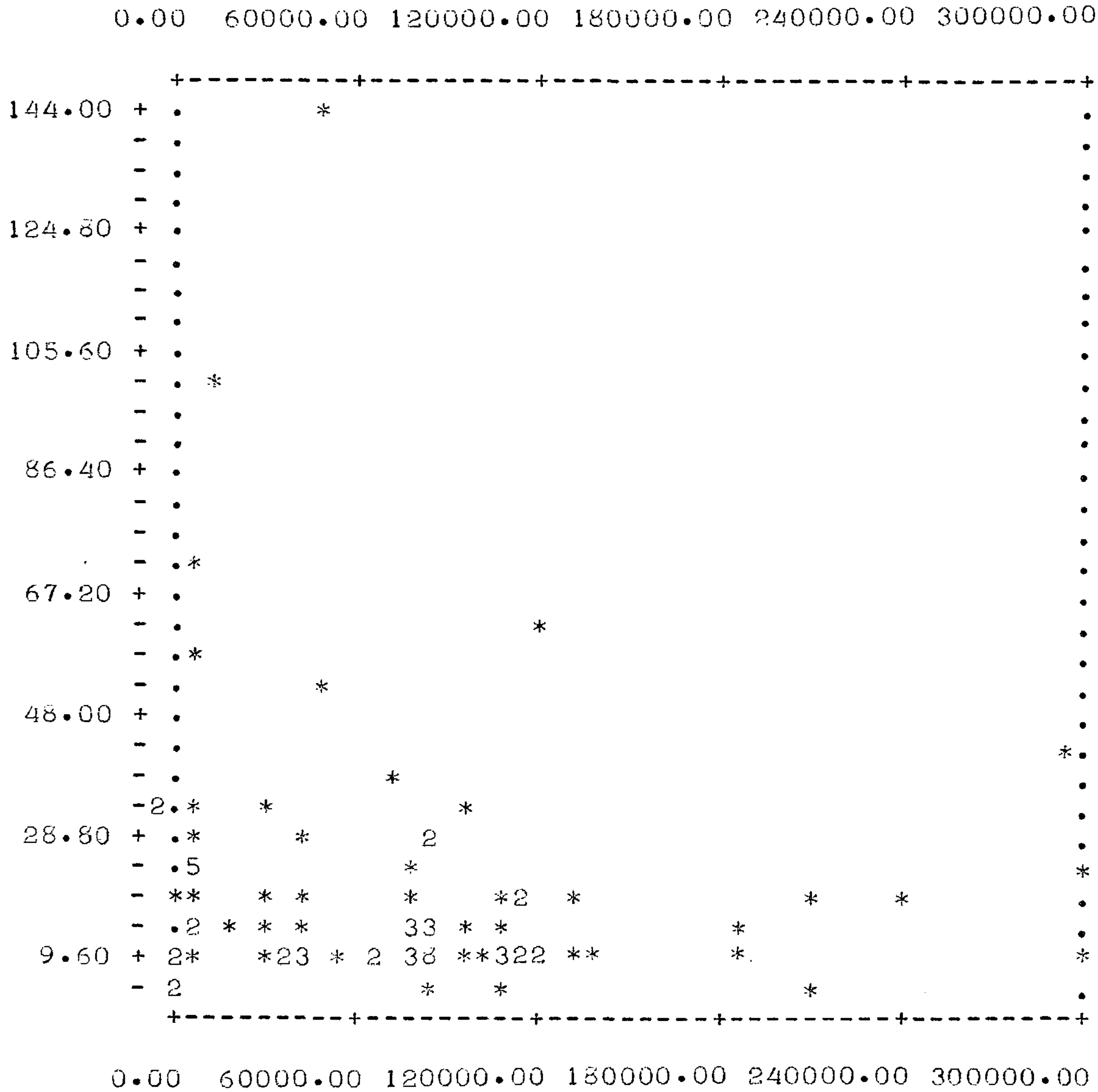
LINEAR CORRELATION COEFFICIENT= 0.030

T= 0.2800

N= 88

LITTER

CODLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 19.0750490000 + -0.0000457811 X XVALUE

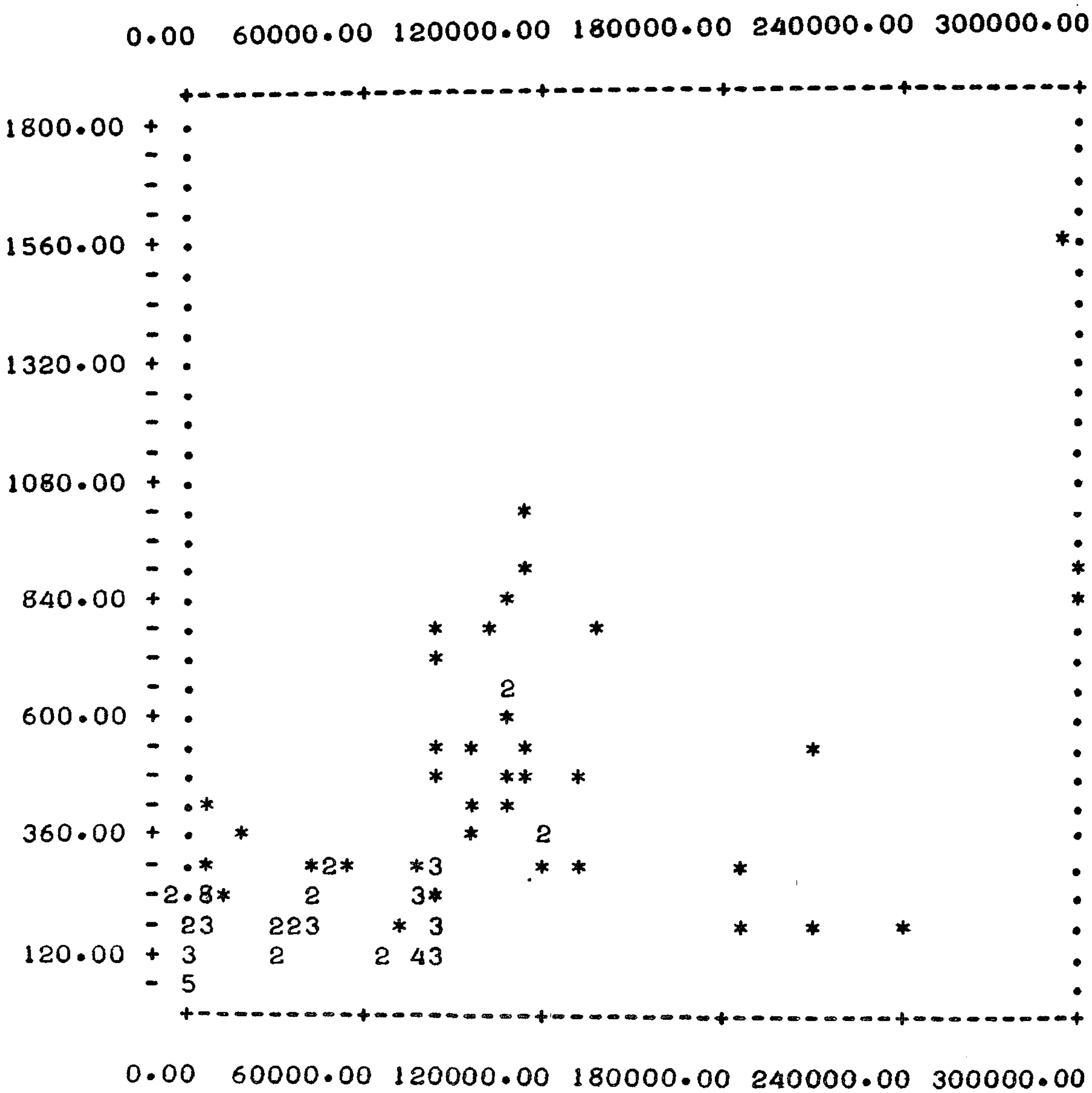
LINEAR CORRELATION COEFFICIENT=-0.144

T= -1.3516

N= 88

TOTAL DUST & DIRT

DRYWTLOAD (VERT) LB/MILE VS. AXLES (HORZ)



LB/MILE = 96.0268380000 + 0.0023848895 X XVALUE

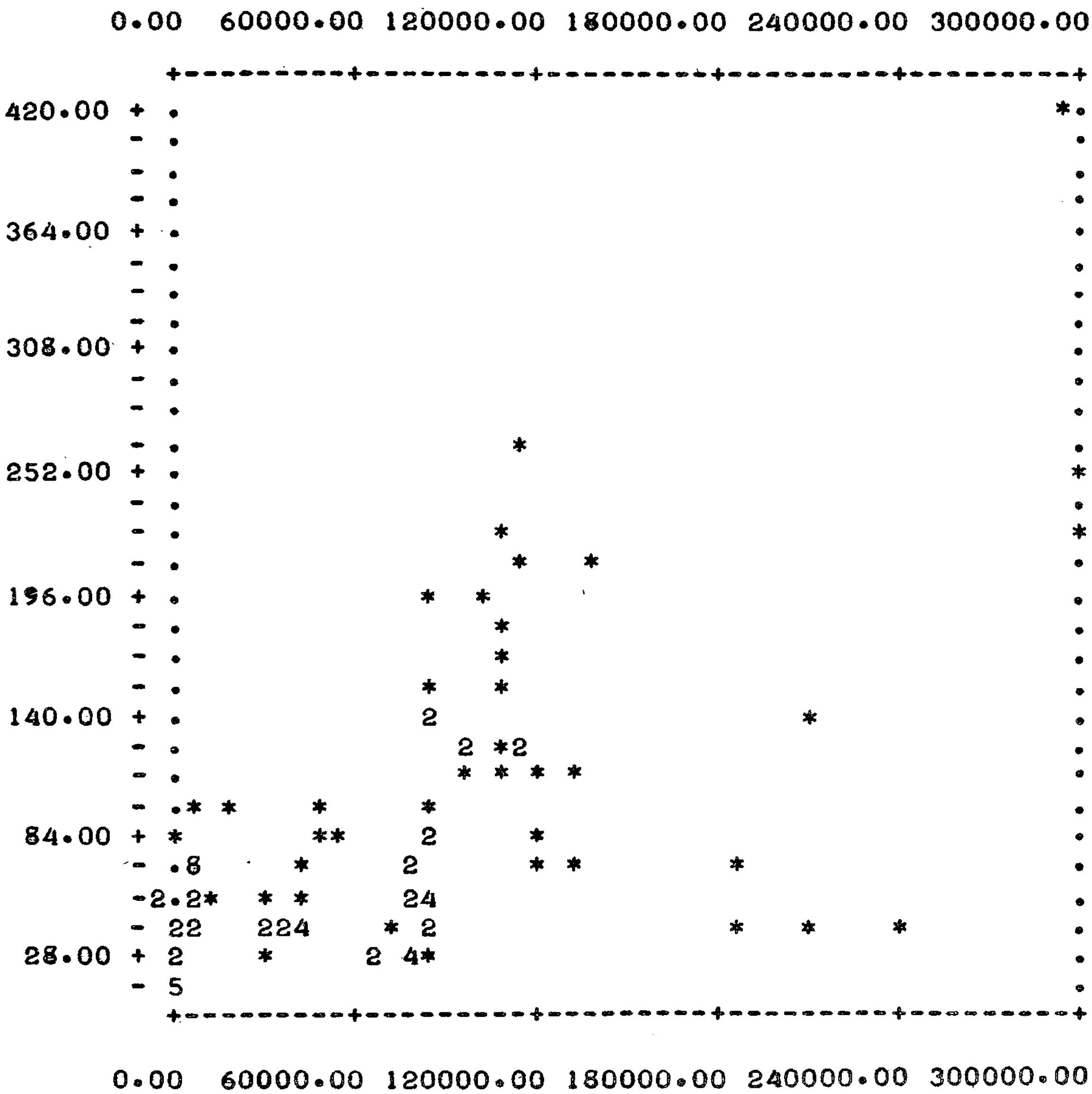
LINEAR CORRELATION COEFFICIENT= 0.597

T= 7.0967

N= 93

DUST & DIRT

VOLUMELOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 26.7195530000 + 0.0006333310 X XVALUE

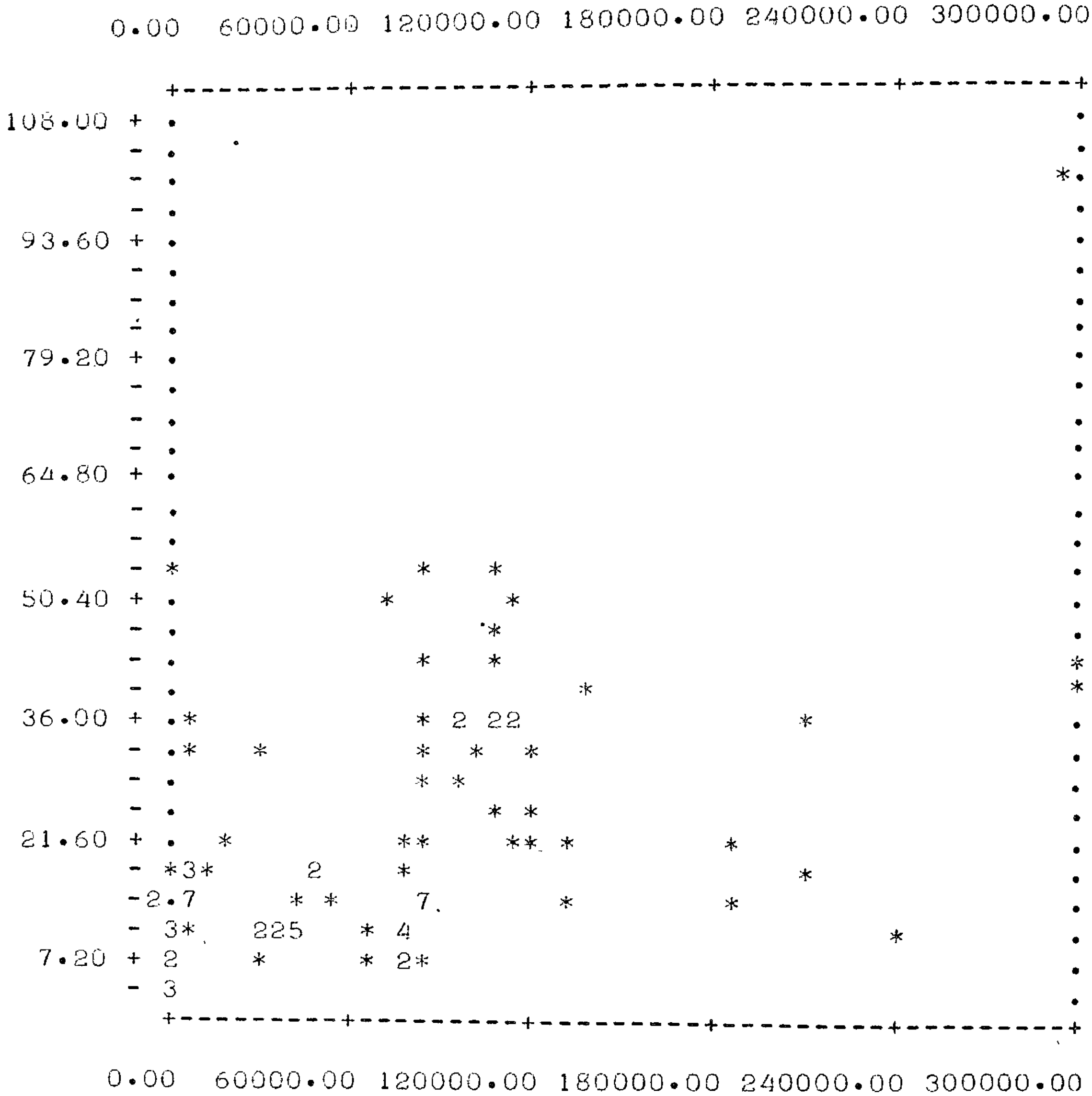
LINEAR CORRELATION COEFFICIENT= 0.612

T= 7.3895

N= 93

TOTAL DUST & DIRT

VOLSLDSLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 10.0441880000 + 0.0001205068 X XVALUE

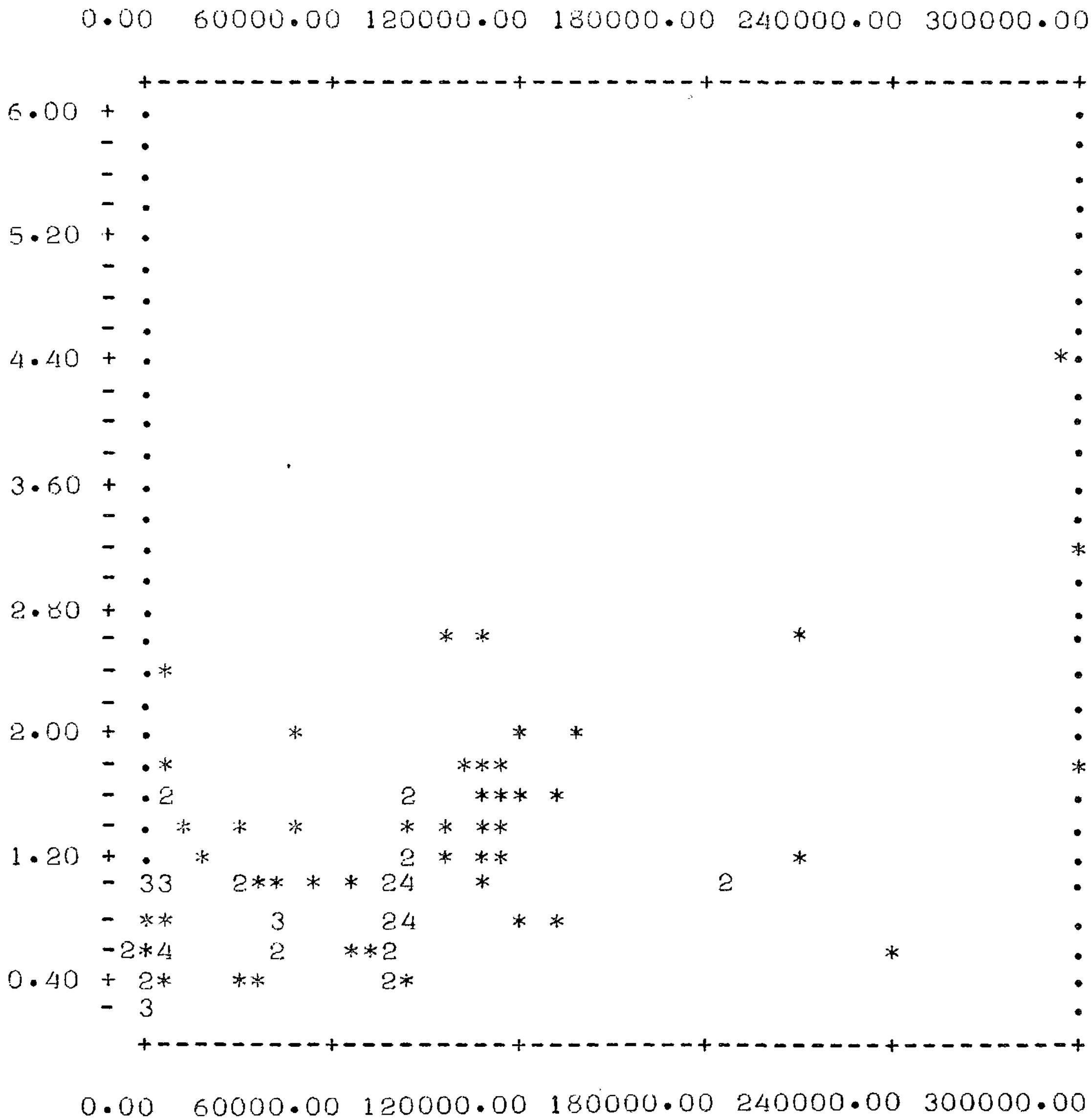
LINEAR CORRELATION COEFFICIENT= 0.502

T= 5.5351

N= 93

TOTAL DUST & DIRT

RCDLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 0.5650034300 + 0.0000054341 X XVALUE

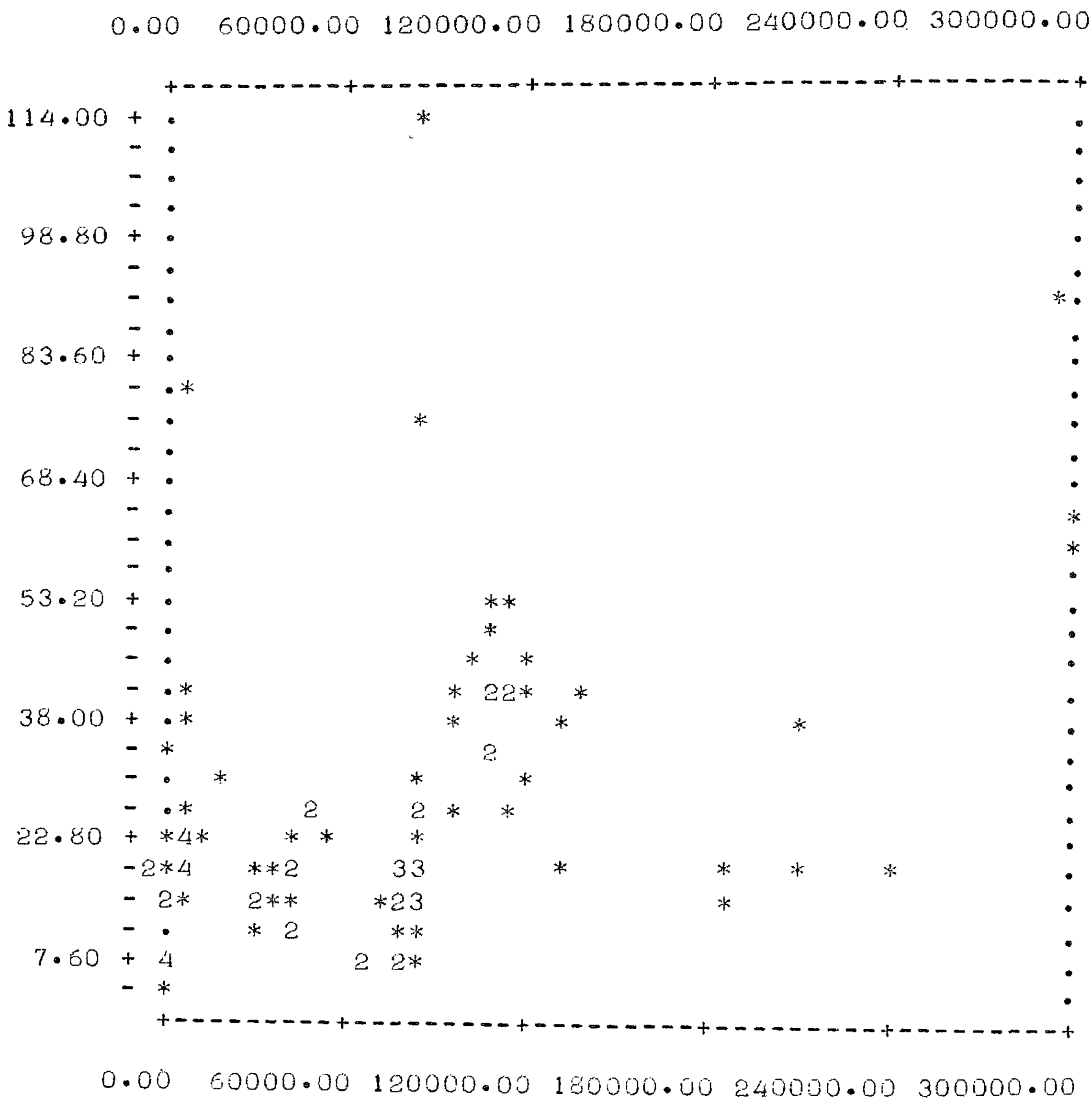
LINEAR CORRELATION COEFFICIENT= 0.524

T= 5.8675

N= 93

TOTAL DUST & DIRT

CODLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 14.6379690000 + 0.0001278816 X XVALUE

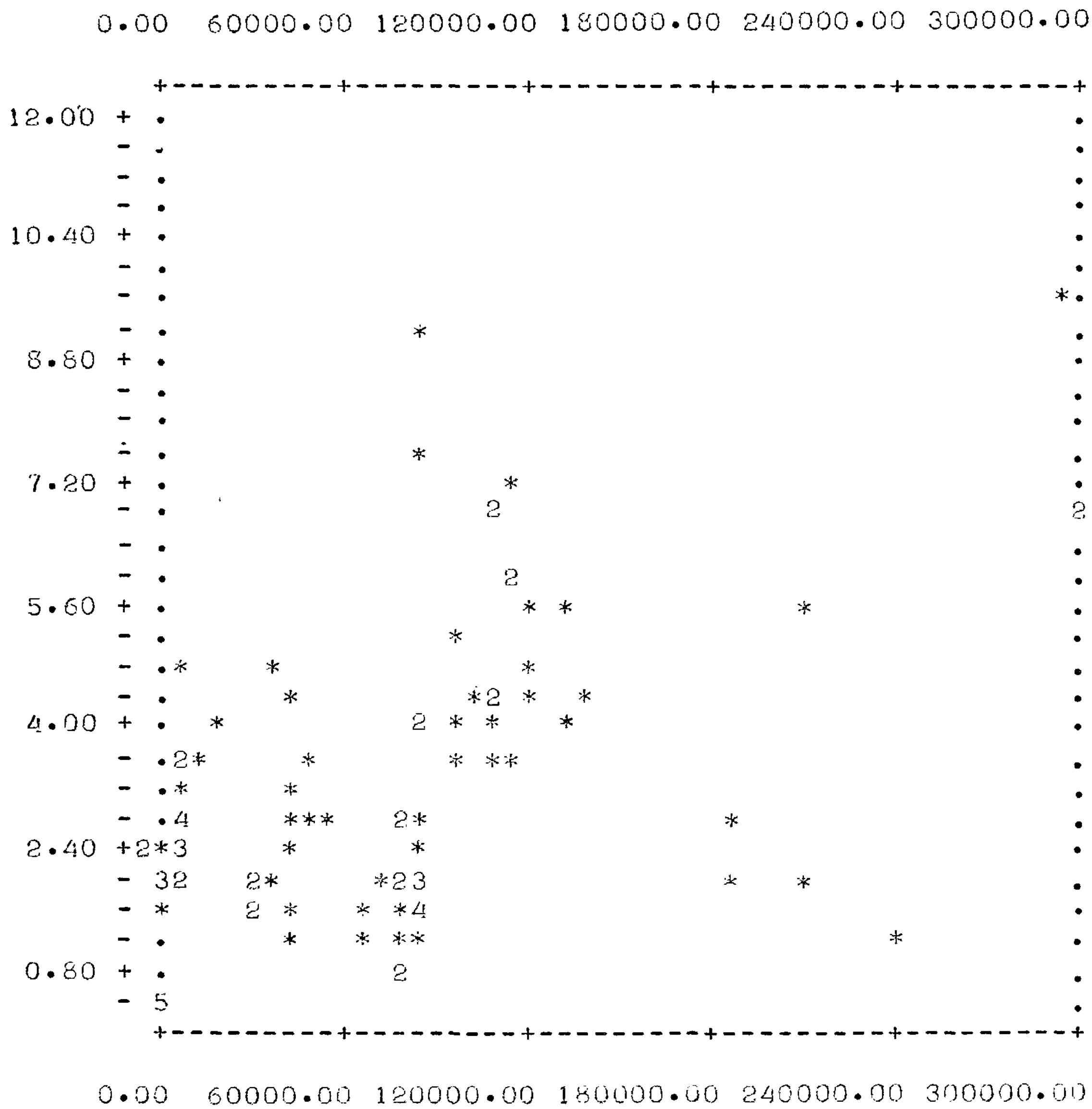
LINEAR CORRELATION COEFFICIENT= 0.434

T= 4.6003

N= 93

TOTAL DUST & DIRT

GREASELOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 1.7347831000 + 0.0000151816 X XVALUE

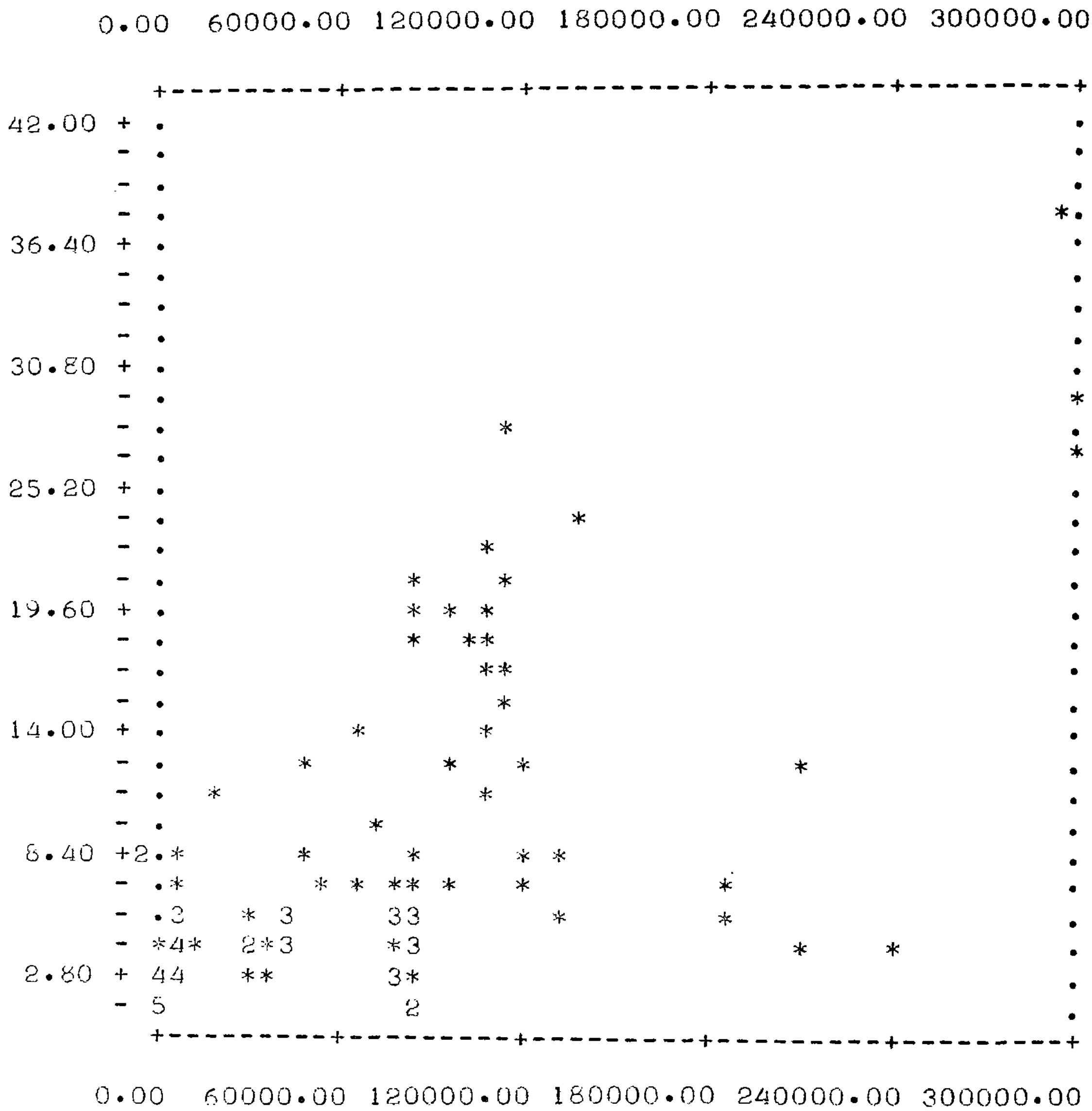
LINEAR CORRELATION COEFFICIENT= 0.508

T= 5.6332

N= 93

TOTAL DUST & DIRT

TOTALPO4LD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+2



LB/MILE = 0.0407208770 + 0.0000014411 X XVALUE

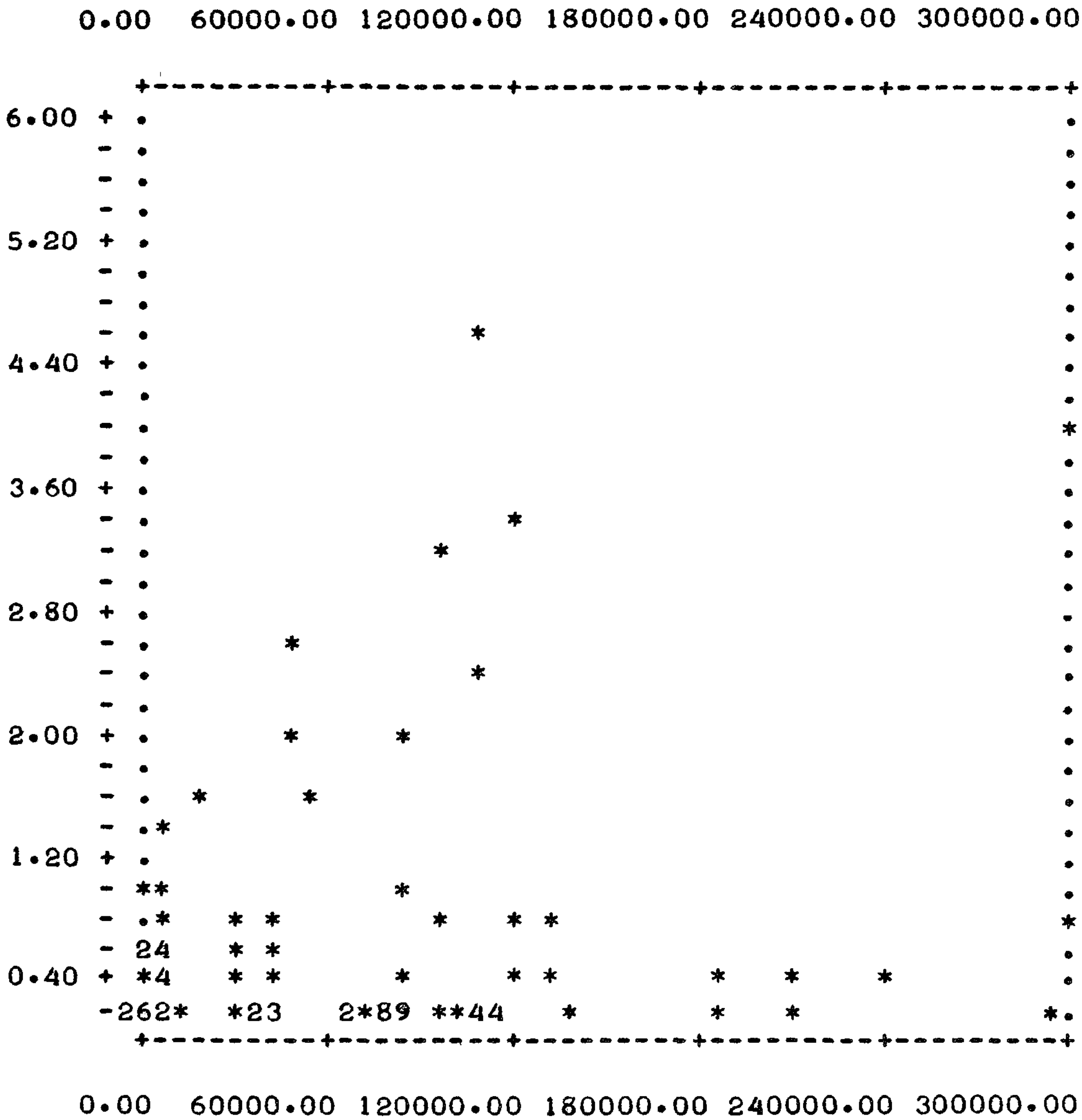
LINEAR CORRELATION COEFFICIENT= 0.635

T= 7.8379

N= 93

TOTAL DUST & DIRT

ORTHOPO4LD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+2



LB/MILE = 0.0058083712 + 0.0000000431 X XVALUE

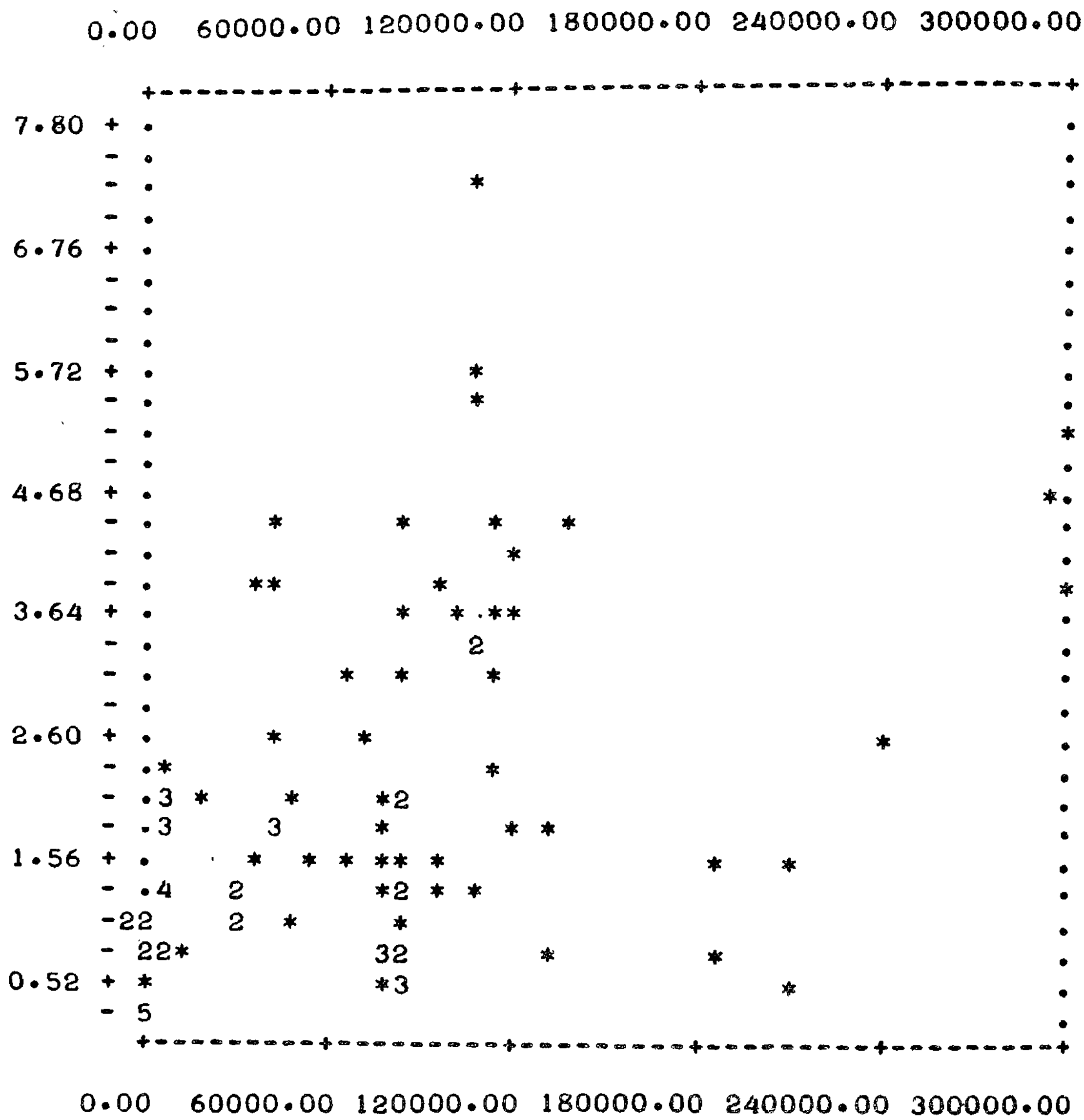
LINEAR CORRELATION COEFFICIENT= 0.167

T= 1.6134

N= 93

TOTAL DUST & DIRT

NO3LOAD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+2



LB/MILE = 0.0225624330 + 0.0000001890 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.423

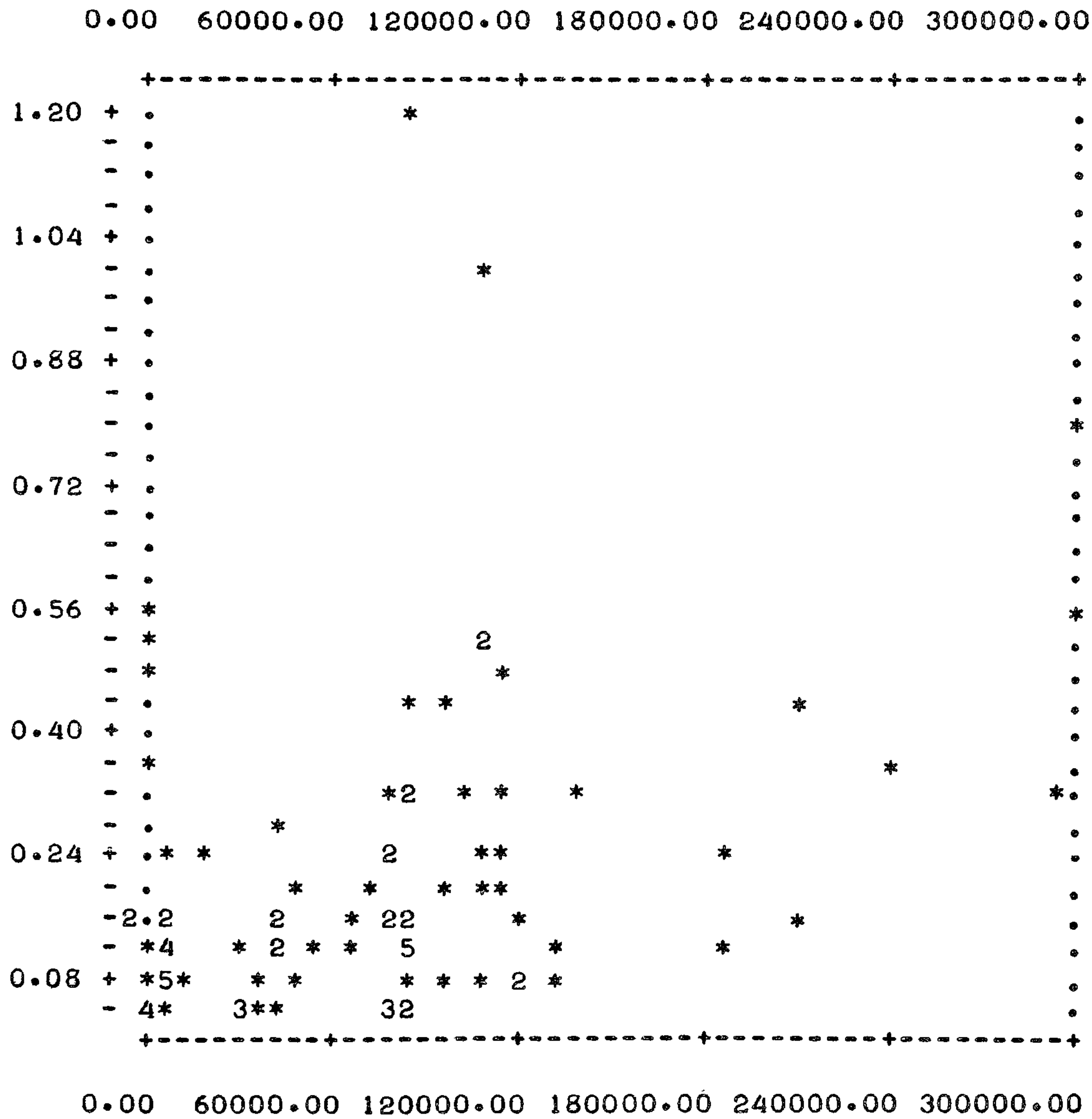
T= 4.4561

N= 93

TOTAL DUST & DIRT

NO2LOAD (VERT) VS. AXLES (HORZ)

LB/MILE X 10EXP+2



LB/MILE = 0.0018116080 + 0.0000000226 X XVALUE

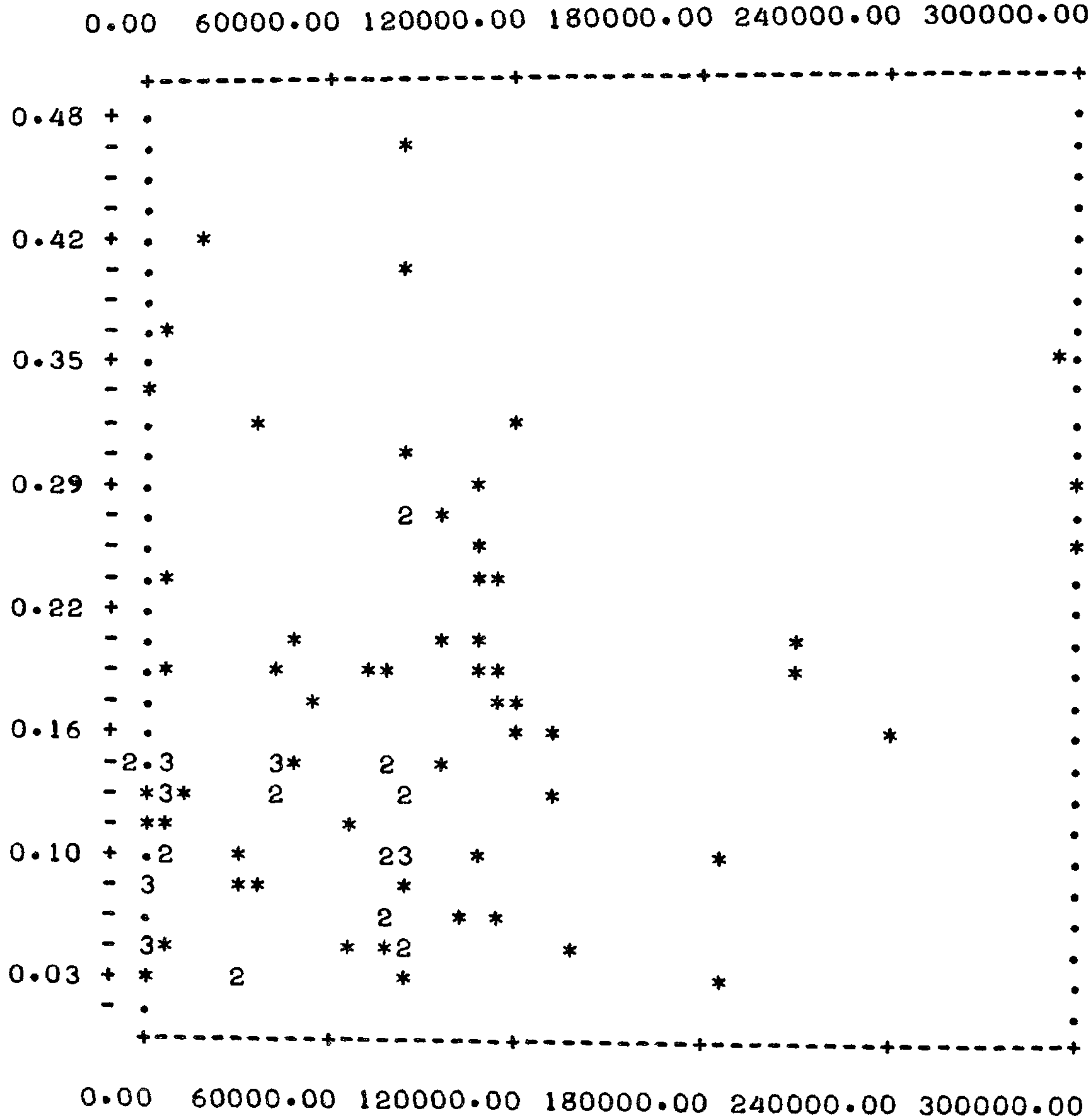
LINEAR CORRELATION COEFFICIENT= 0.360

T= 3.6866

N= 93

TOTAL DUST & DIRT

TKNLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 0.1164142600 + 0.0000003716 X XVALUE

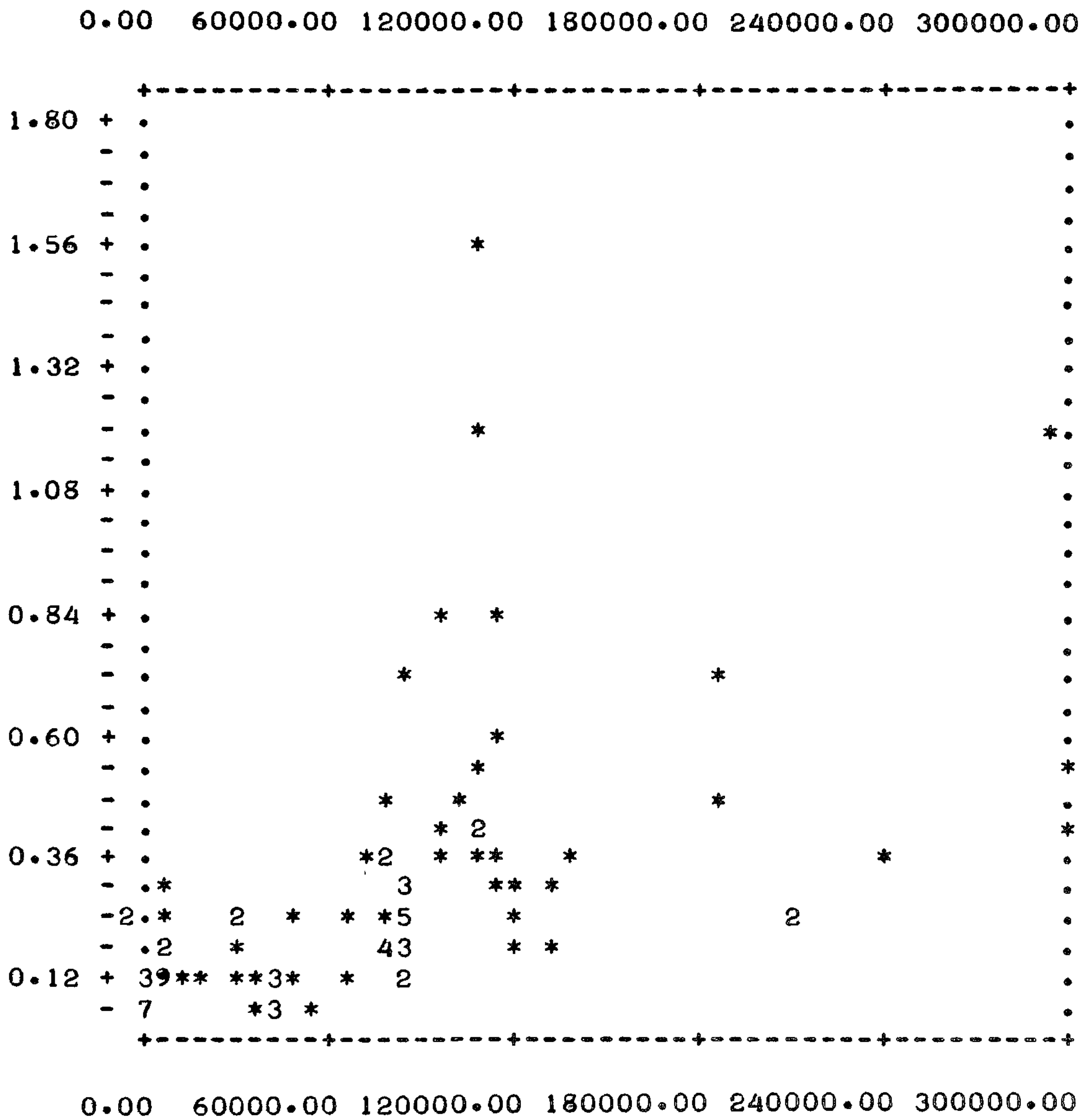
LINEAR CORRELATION COEFFICIENT= 0.250

T= 2.4651

N= 93

TOTAL DUST & DIRT

CHLORIDELD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 0.0624241290 + 0.0000021962 X XVALUE

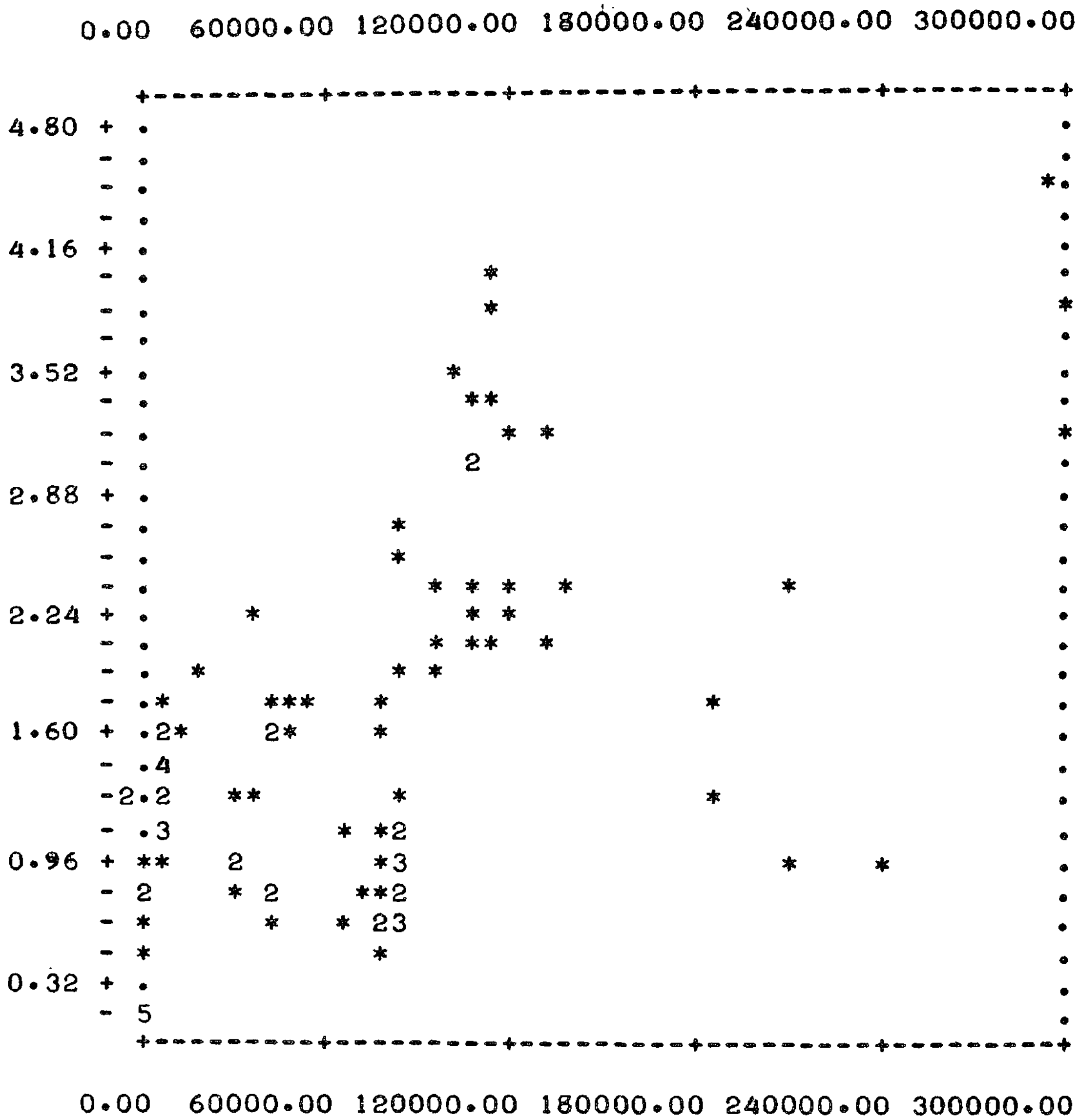
LINEAR CORRELATION COEFFICIENT= 0.547

T= 6.2252

N= 93

TOTAL DUST & DIRT

PETROLOAD (VERT) VS. .AXLES (HORZ)
LB/MILE



LB/MILE = 0.8380789500 + 0.0000085206 X XVALUE

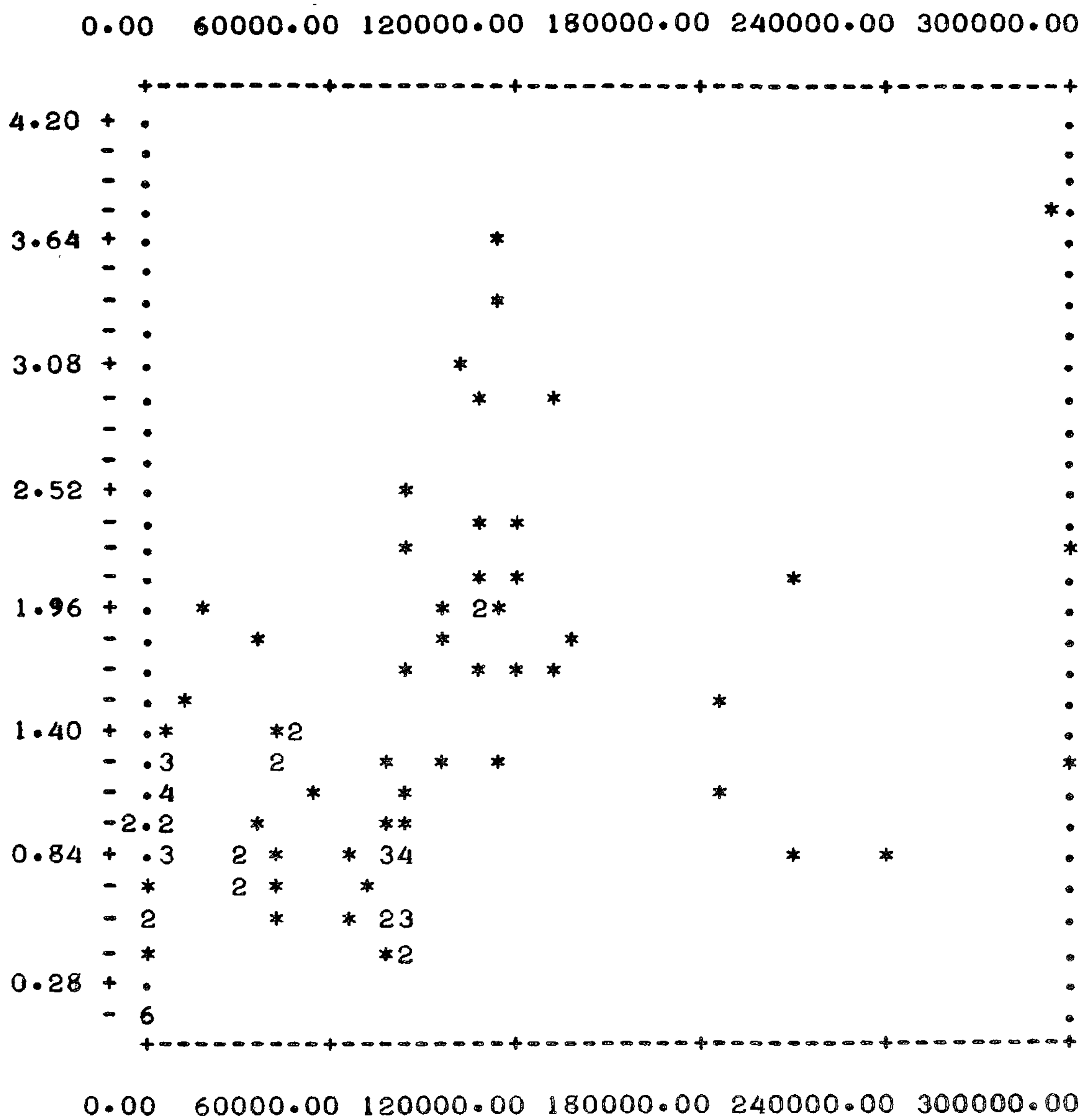
LINEAR CORRELATION COEFFICIENT= 0.573

T= 6.6758

N= 93

TOTAL DUST & DIRT

PARAFFINLD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 0.7036556200 + 0.0000059903 X XVALUE

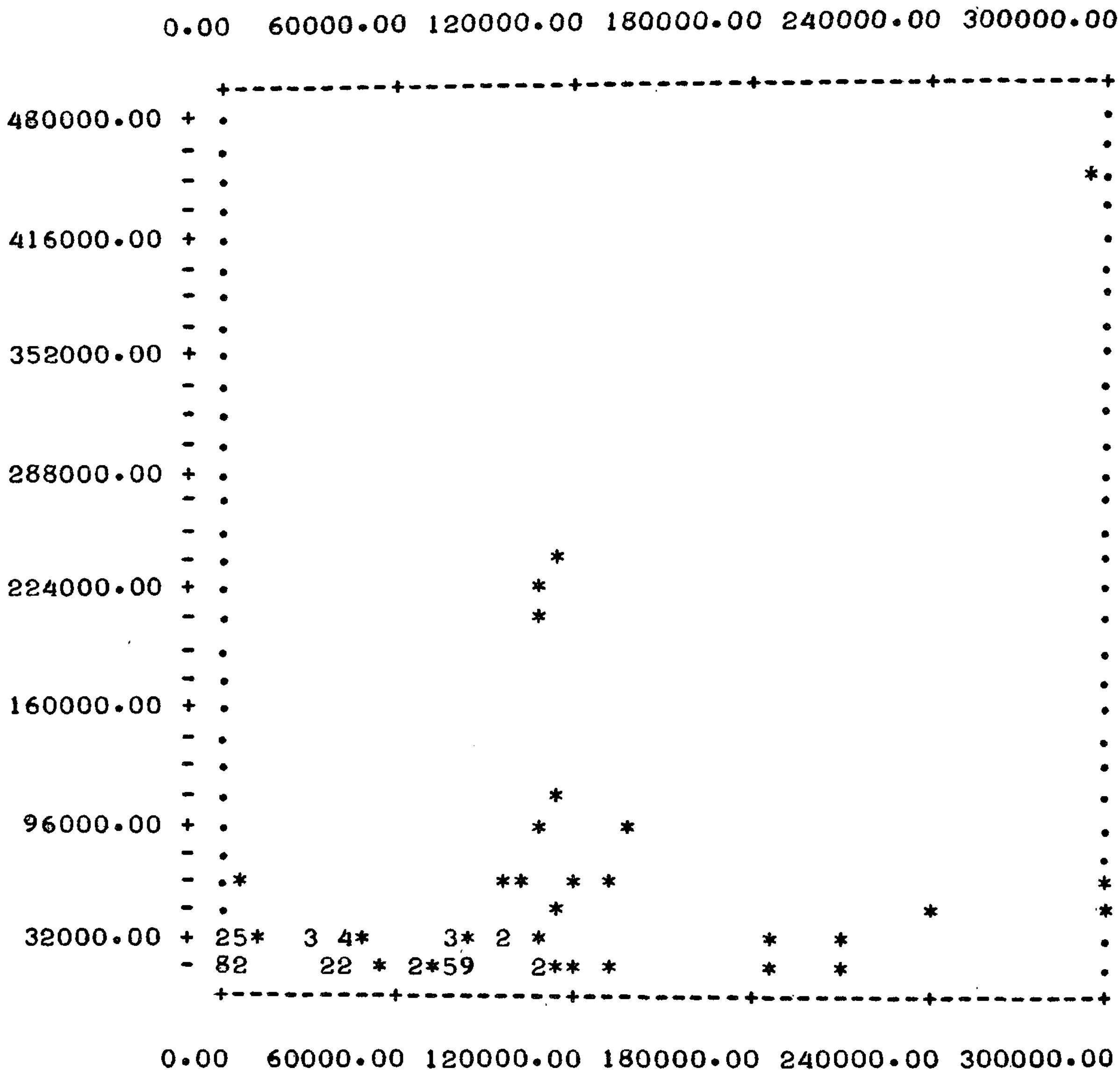
LINEAR CORRELATION COEFFICIENT= 0.492

T= 5.3914

N= 93

TOTAL DUST & DIRT

ASBESTOSLD (VERT) VS. AXLES (HORZ)
FIBERS/MILE X 10EXP-6



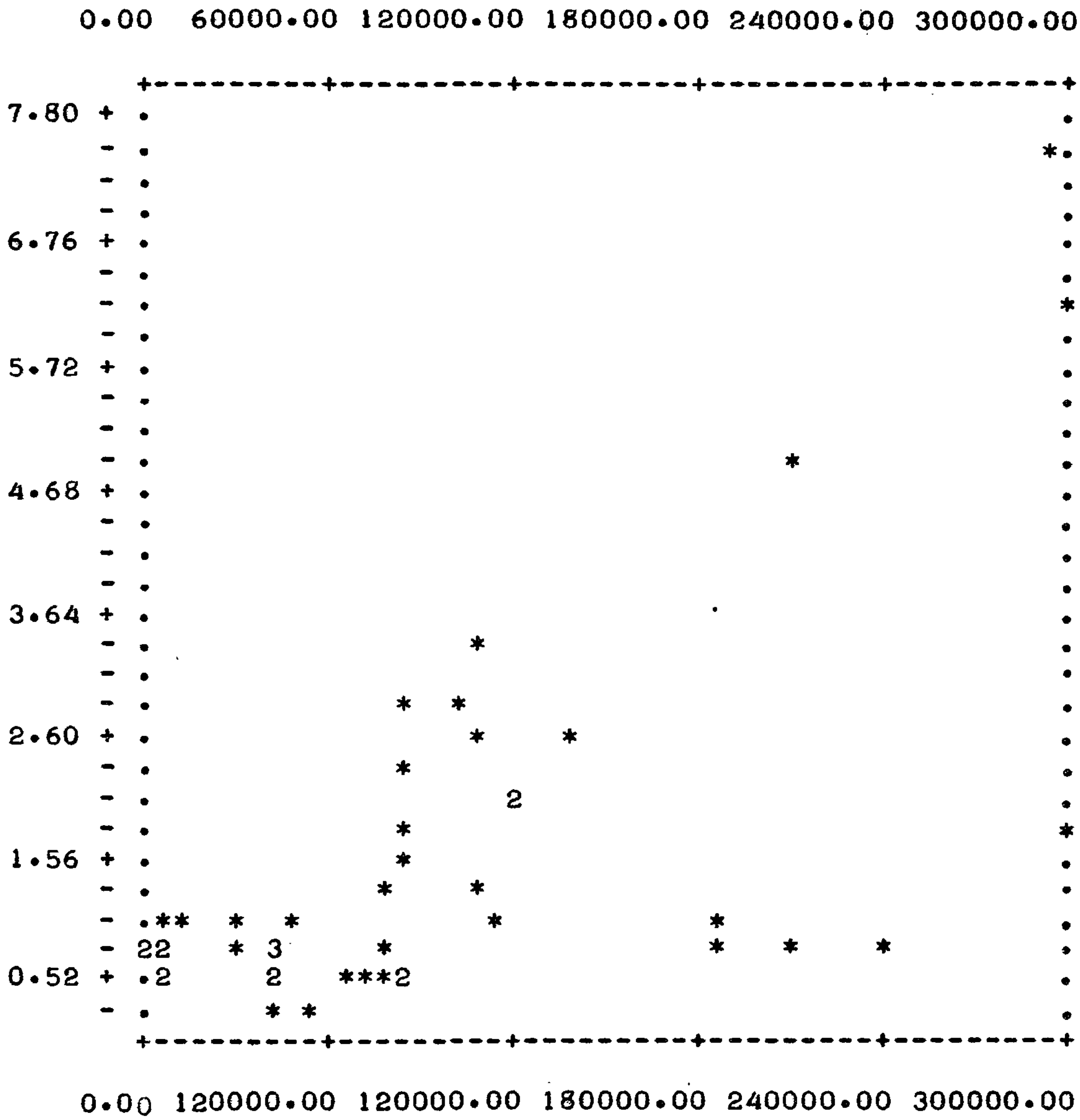
FBRS/MILE= -4812.0518000000 + 0.3862825000 X XVALUE
X 10EXP-6
LINEAR CORRELATION COEFFICIENT= 0.415

T= 4.1267

N= 84

DUST & DIRT

RUBBERLOAD (VERT) VS. AXLES (HORZ)
LB/MILE



LB/MILE = 0.1376632900 + 0.0000124289 X XVALUE

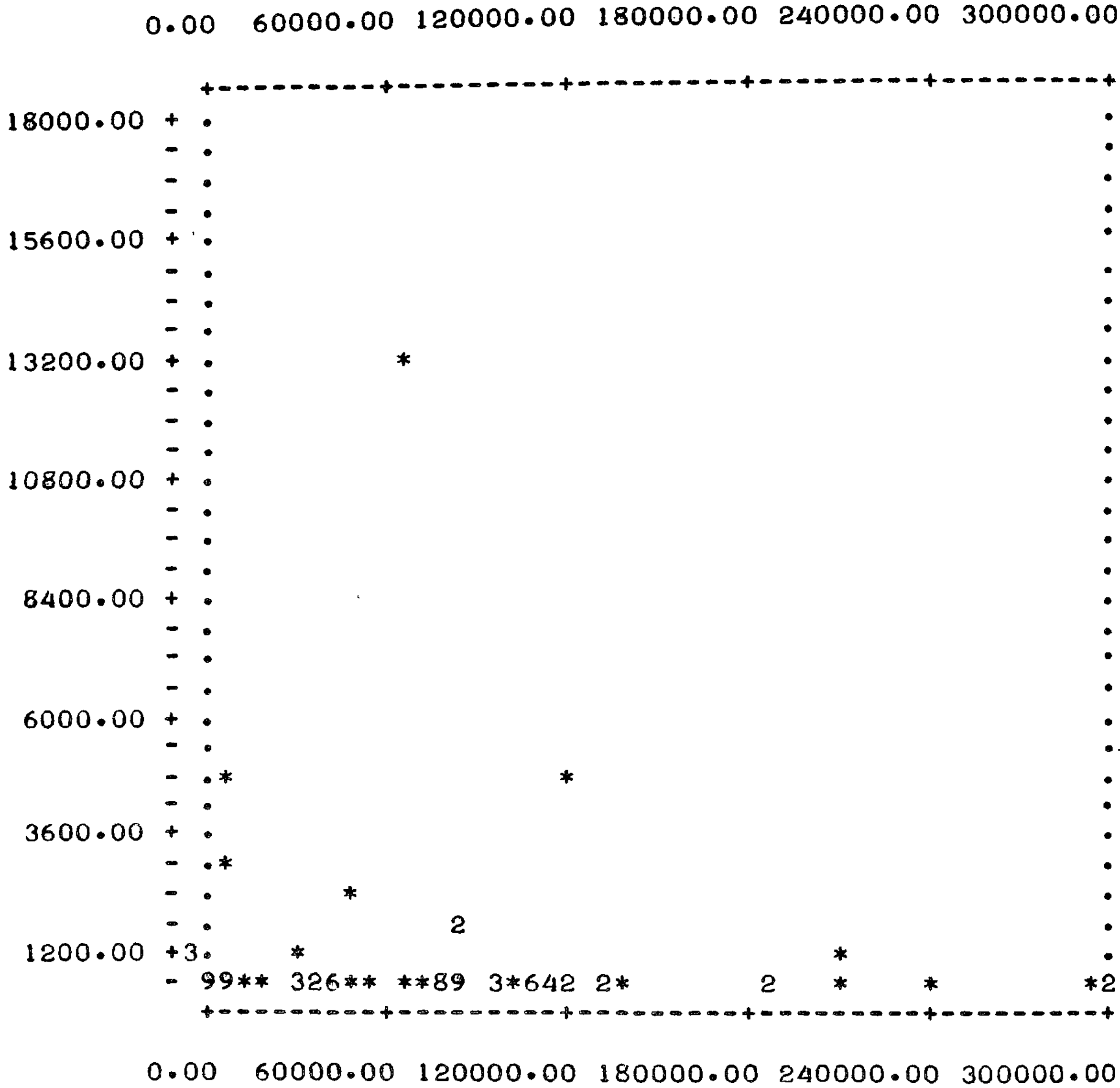
LINEAR CORRELATION COEFFICIENT= 0.637

T= 5.4142

N= 45

TOTAL DUST & DIRT

COLIFORMLD (VERT) VS. AXLES (HORZ)
ORG/MILE X 10EXP-6



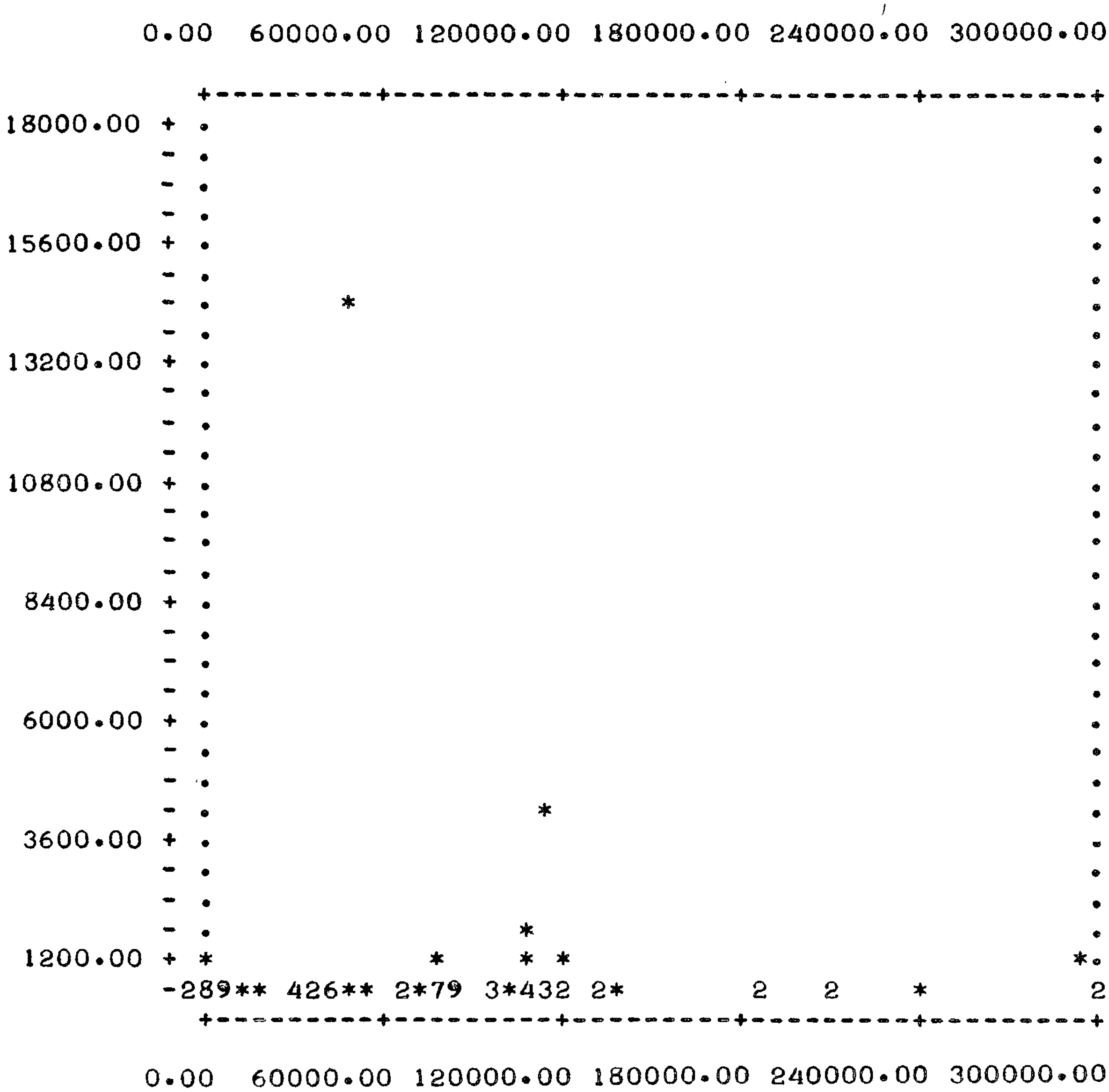
ORG/MILE = 427.8490600000 + -0.0010032825 X XVALUE
X 10EXP-6
LINEAR CORRELATION COEFFICIENT=-0.044

T= -0.4139

N= 92

TOTAL DUST & DIRT

STREPLOAD (VERT) VS. AXLES (HORZ)
ORG/MILE X 10EXP-6



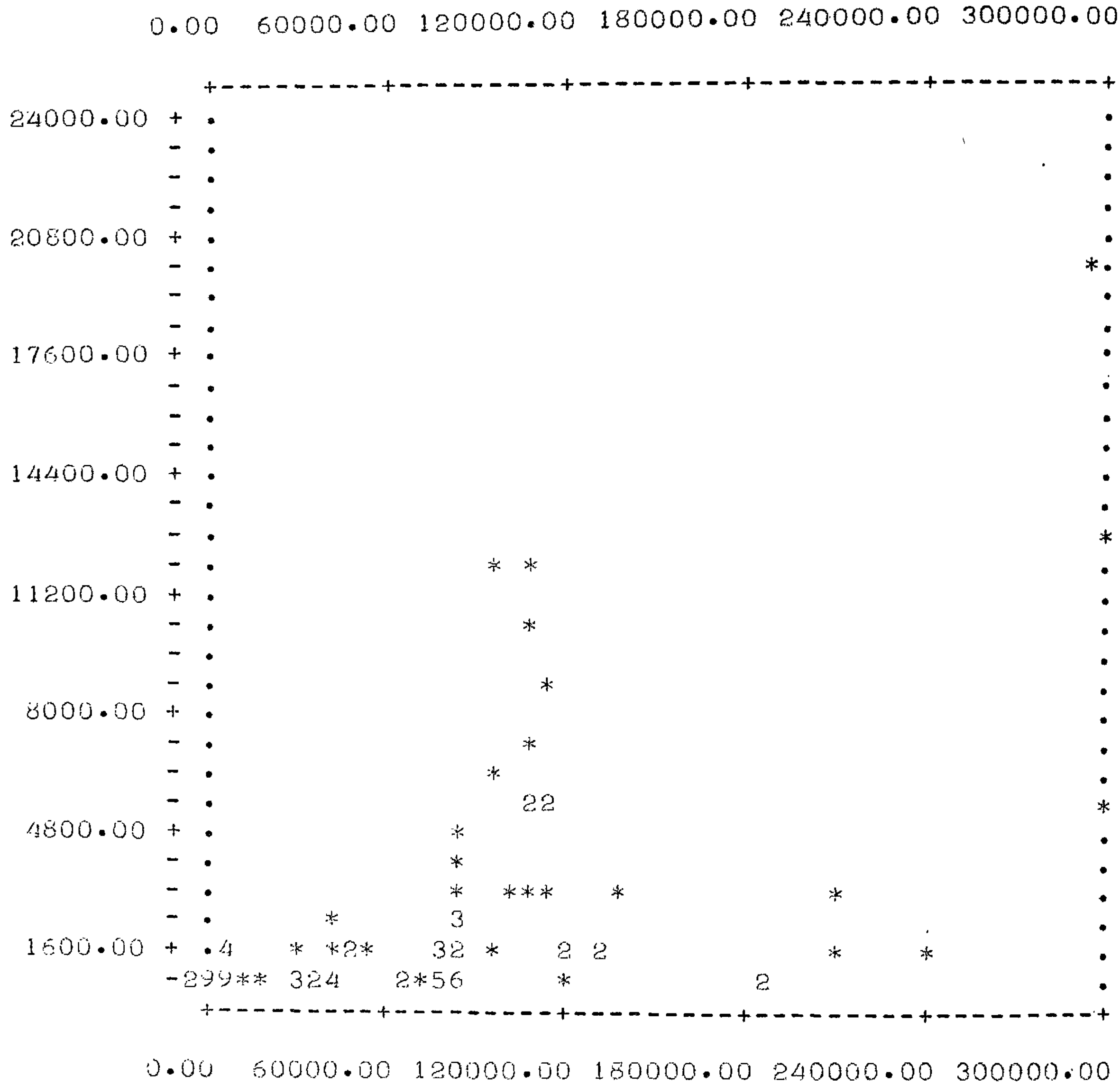
ORG/MILE = 284.2169600000 + -0.0003311105 X XVALUE
X 10EXP-6
LINEAR CORRELATION COEFFICIENT=-0.015

T= -0.1395

N= 92

TOTAL DUST & DIRT

LEADLOAD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+3



LB/MILE = -0.3451714500 + 0.0000278910 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.572

T= 6.6473

N= 93

TOTAL DUST & DIRT

CHROMIUMLD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+4

```
       0.00  60000.00 120000.00 180000.00 240000.00 300000.00

          +---------+---------+---------+---------+---------+
2404.00 + .                  *                              .
        - .                                                 .
        - .                                                 .
        - .                                                 .
2084.00 + .                                                 .
        - .                                                 .
        - .                  *                              .
        - .                                                 .
1764.00 + .                                                 .
        - .                                                 .
        - .                                                 .
        - .                                                 .
1444.00 + .                 *                               .
        - .                      *                          .
        - .                                                 .
        - .                                                 .
1124.00 + .                *                                *
        - .                                                 .
        - .                  *                              .
        - .                                                 .
 804.00 + .                                                 .
        - .                                                 .
        - .                 *                              *.
        - .                                                 .
 484.00 + .                                                 .
        - .* *         2    *   *                           *
        - *5     2**   *2 * * 2 *                           .
        - *4     3*    *4 * ***          *        *         .
 164.00 + *3   22*   **36   *            *   2              .
        - 53*  2     * *2 *                                 .
          +---------+---------+---------+---------+---------+

       0.00  60000.00 120000.00 180000.00 240000.00 300000.00
```

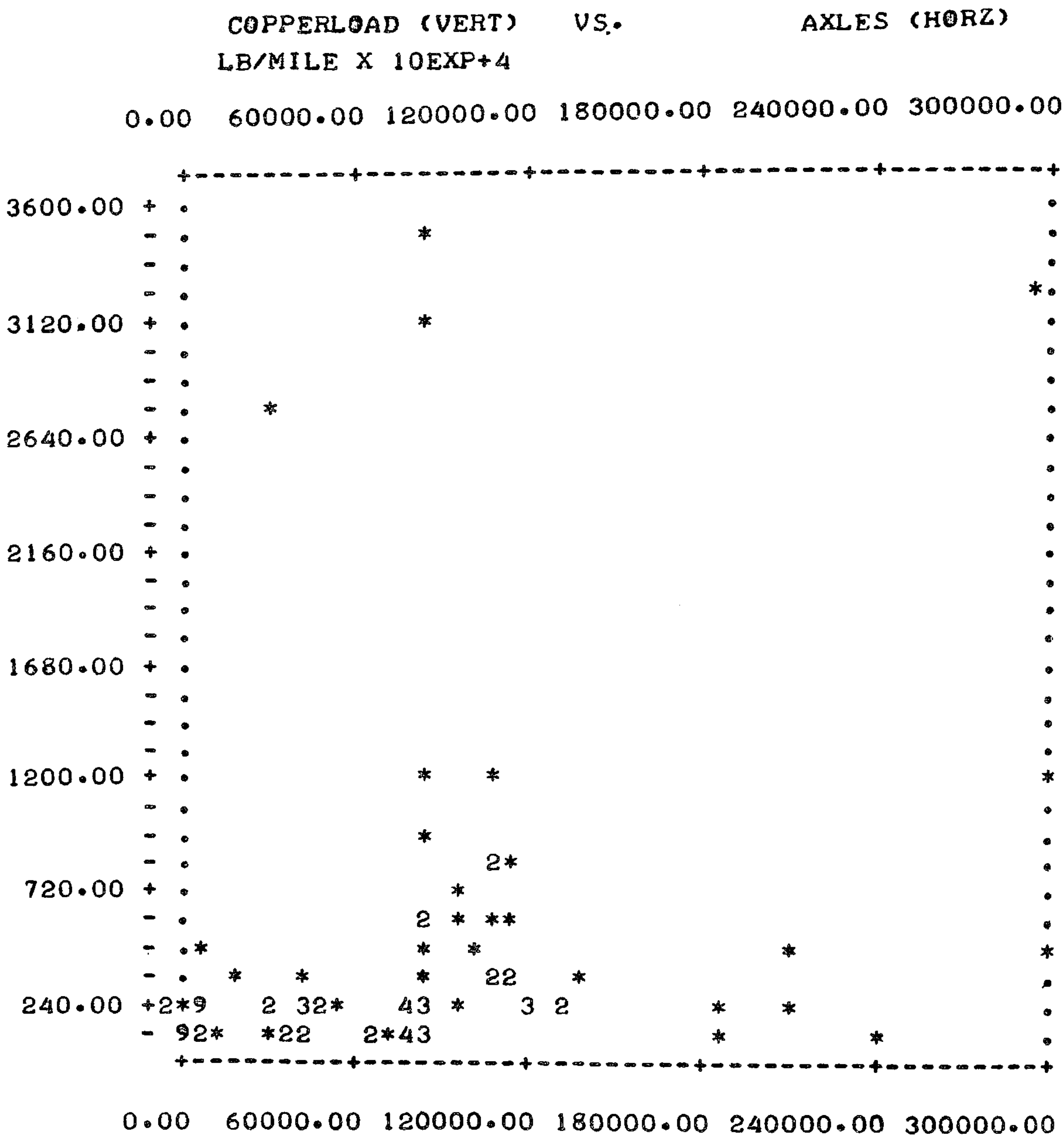
LB/MILE = 0.0114907390 + 0.0000001847 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.321

T= 3.2293

N= 93

TOTAL DUST & DIRT



LB/MILE = 0.0120903890 + 0.0000002842 X XVALUE

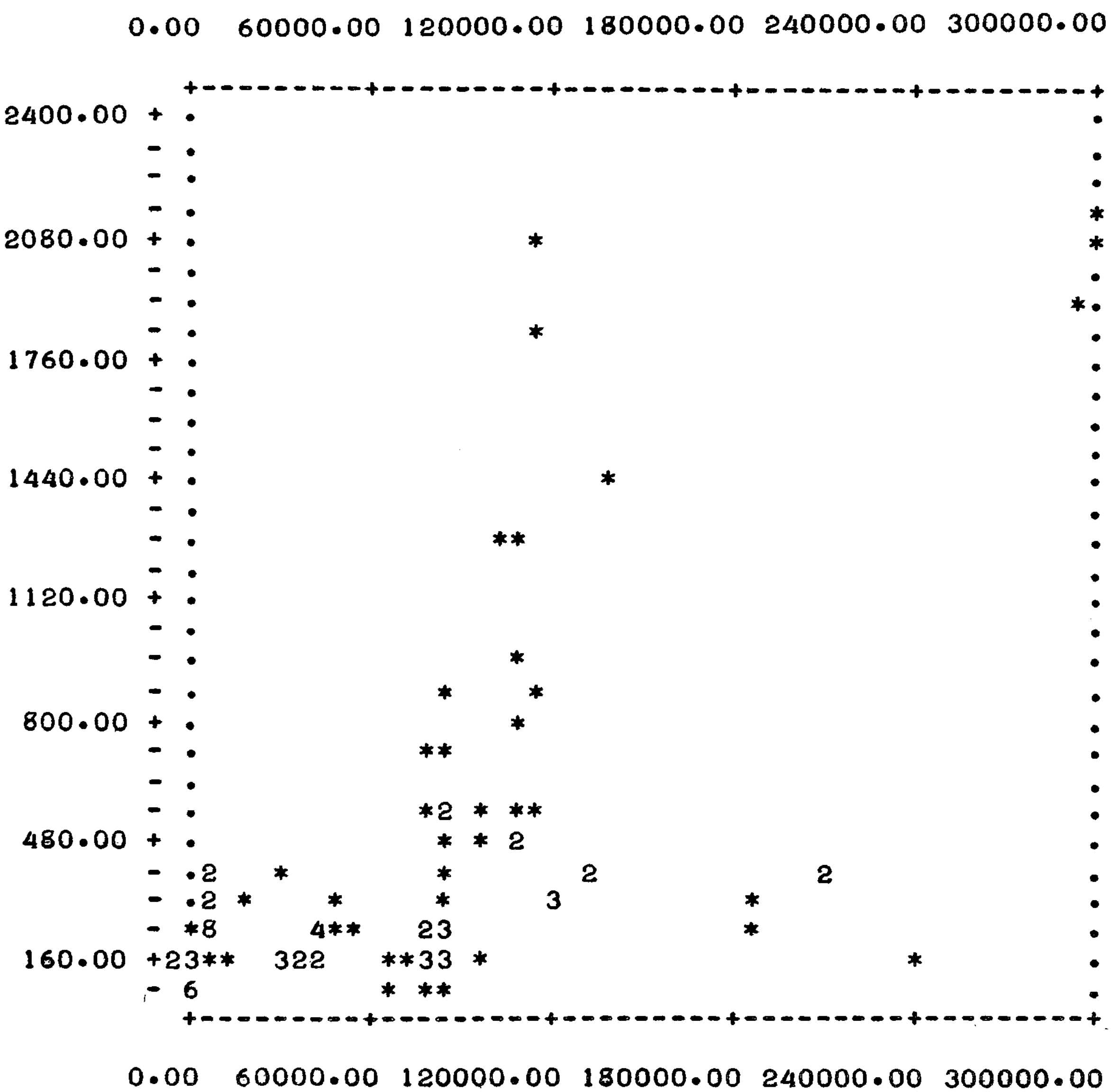
LINEAR CORRELATION COEFFICIENT= 0.295

T= 2.9412

N= 93

TOTAL DUST & DIRT

NICKELLOAD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+4



LB/MILE = 0.0032283994 + 0.0000004397 X XVALUE

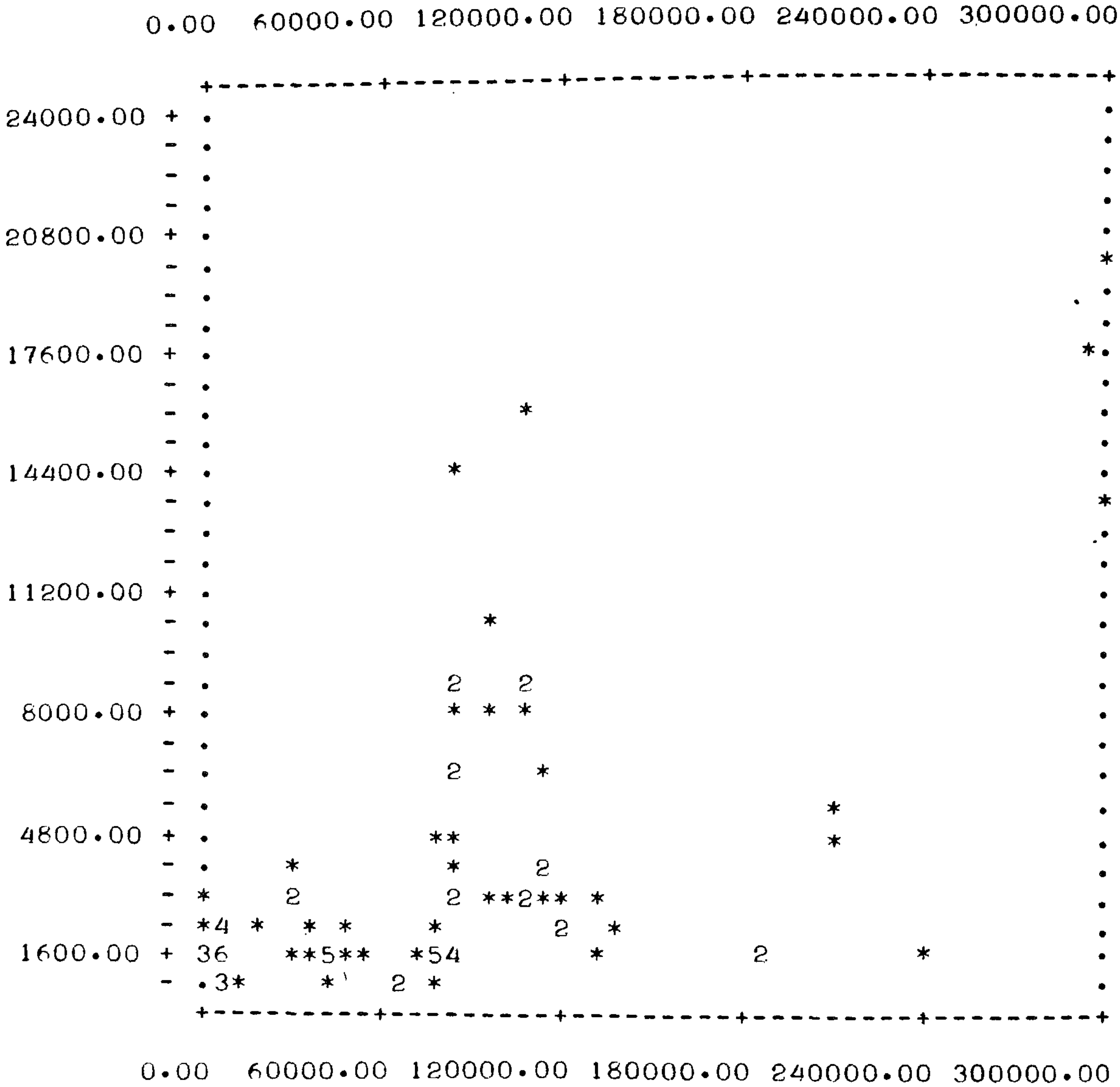
LINEAR CORRELATION COEFFICIENT= 0.616

T= 7.4634

N= 93

TOTAL DUST & DIRT

ZINCLOAD (VERT) VS. AXLFS (HORZ)
LB/MILE X 10EXP+4



LB/MILE = 0.0341444240 + 0.0000035045 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.589

T= 6.7573

N= 88

DUST & DIRT

CADMIUMLOAD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+6

```
          0.00   60000.00 120000.00 180000.00 240000.00 300000.00

              +---------+---------+---------+---------+---------+
180000.00 +   .                                                 .
          -   .                                                 .
          -   .                *                                .
          -   .                                                 .
156000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
132000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
108000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
 84000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
 60000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
 36000.00 +   .                                                 .
          -   .                                                 .
          -   .                                                 .
          -   .                                                 .
 12000.00 +   .                                                 .
          -229 * 3262* 2*87  *333 2*       2    *    *          *
              +---------+---------+---------+---------+---------+

          0.00   60000.00 120000.00 180000.00 240000.00 300000.00
```

LB/MILE = 0.0009093660 + 0.0000000311 X XVALUE

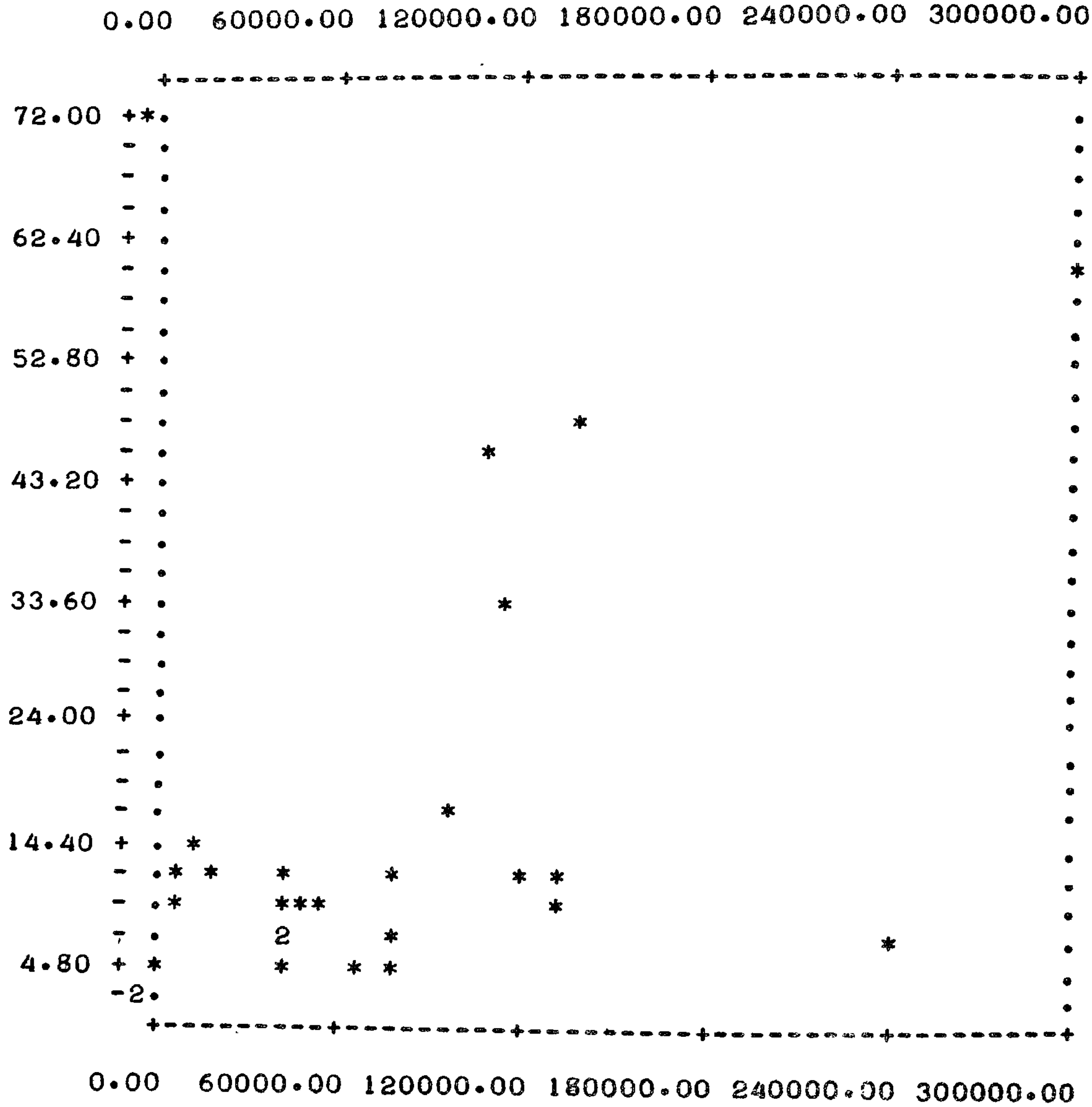
LINEAR CORRELATION COEFFICIENT= 0.088

T= 0.6970

N= 64

DUST & DIRT

MAGFRACTION (VERT) VS. AXLES (HORZ)
LB/MILE



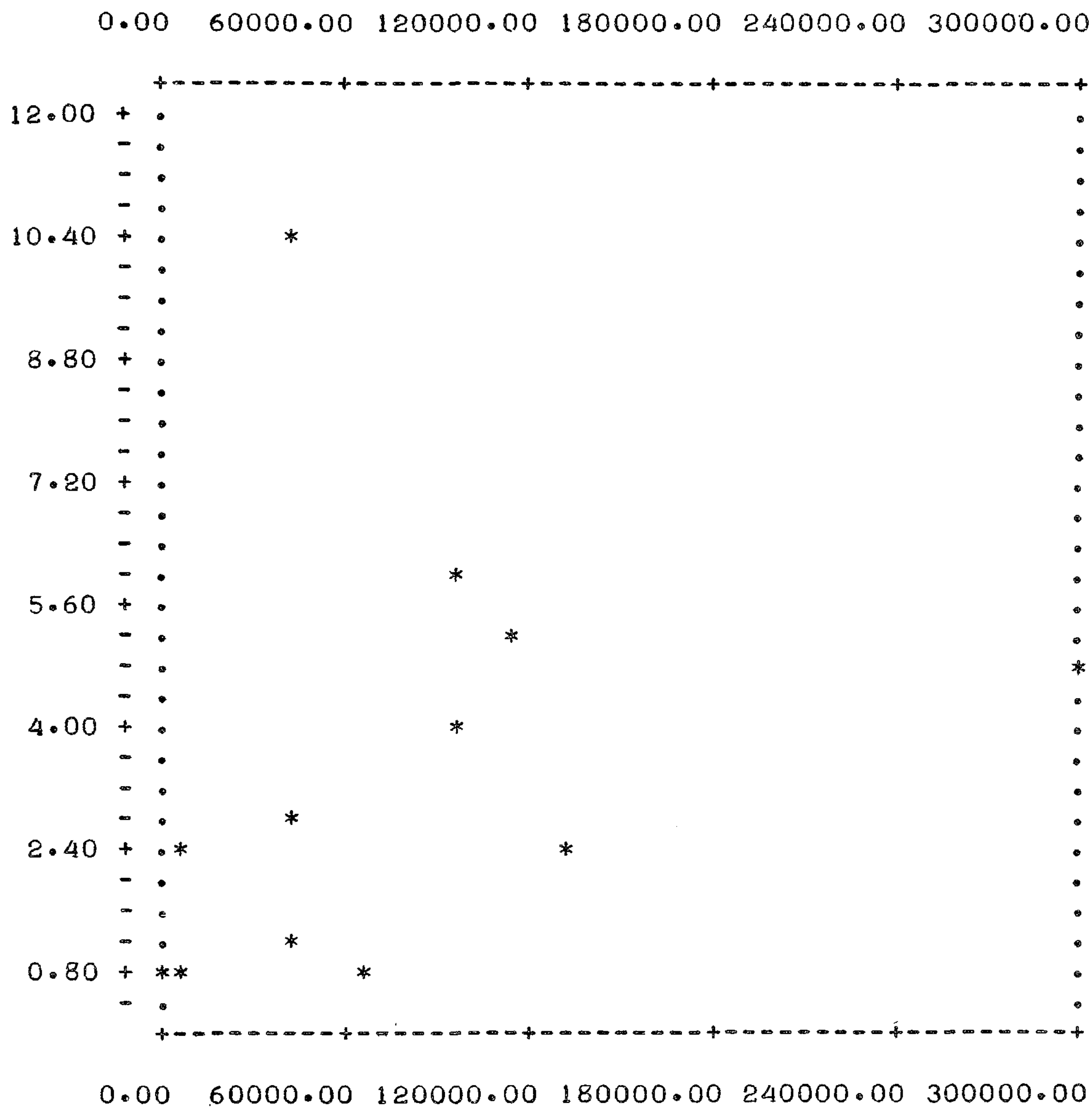
LB/MILE = 2.9111505000 + 0.0001262000 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.587

T= 3.4772

N= 25

PCBLOAD (VERT) VS. AXLES (HORZ)
LB/MILE X 10EXP+4



Y(LB/MI) = 0.0002352577 + 0.0000000010 X XVALUE

LINEAR CORRELATION COEFFICIENT= 0.294

T= 0.9717

N= 12.0

APPENDIX E

SAMPLING PROCEDURE FOR THE COLLECTION OF STREET SURFACE CONTAMINANTS

EQUIPMENT

- Hard bristle broom
- Alternator power plant, 3500 watt, Dayton Electric Manufacturing Co., Model No. 1W832A
- Two wet and dry vacuum cleaners, 10 gallon, Dayton Electric Manufacturing Co., Model 2Z612
- Steel drum, 55 gallon, with lid and rim lock, containing 40 to 50 gallons of water
- Rotary screw pump, 3.5 amperes, Dayton Electric Manufacturing Co., Model No. 3P569
- Garden hose, 100 feet
- Dual motor shop wet and dry vacuum, Dayton Electric Manufacturing Co., Model No. 3Z107 mounted on a 55 gallon steel drum
- Sand bags

PROCEDURE

1. Select a roadway sampling area of 100 curb feet or more. The street surface and curbing should be in relatively good condition.

2. Brush along the curb on both sides adjacent to the roadway sampling area for 10 to 15 feet away from the area.

3. Vacuum along the entire curb length of the roadway sampling site out to a distance of from four to five feet from the curb. Three vacuumings of the site should be carried out to collect the litter and dust and dirt sample fractions. Two vacuum cleaners are used simultaneously to speed up the operation.

4. Position several sand bags at the curb of the lower end of the sampling area to impound the flush water.

5. Place the nozzle of the dual motor shop vacuum at a low point in front of the sand bags so as to suck water into the 55-gallon drum.

6. Place the intake hose from the rotary screw pump into the 55-gallon drum filled with water and begin flushing the roadway using the garden hose.

7. Flush the entire roadway surface area toward the curb and finish by flushing the curb area toward the sand bags.

8. Approximately 15 to 25 gallons of water are required to flush 600 to 1000 square feet of roadway. Generally greater than 50 percent of the flush water applied is recovered by the vacuum.

APPENDIX F

ANALYTICAL METHODS FOR ROADWAY SAMPLES

SAMPLE PREPARATION AND DRY WEIGHT AND VOLUME MEASUREMENTS

Summary

Roadway samples are returned to the laboratory and air-dried, if necessary, prior to separation into litter and dust and dirt fractions.

Equipment

C. E. Tyler RoTap Sieve Shaker
U.S.A. No. 6 Sieve (3.35 mm Openings) with Cover and Bottom
Top Loading and Analytical Balances
Graduated Cylinders, 5 Liter and 1 Liter Capacity
Aluminum Foil
Scissors
Blender
Mortar and Pestle
Porcelain Crucible, 60 ml Capacity
Drying Oven

Procedure

1. If the roadway particulates are damp, spread them out on aluminum foil for overnight drying at room temperature.

2. Separate the samples into litter particles (larger than 3.35 mm) and dust and dirt fractions (particles smaller than 3.35 mm) using a U.S.A. No. 6 sieve and the RoTap Sieve Shaker.

3. Weigh and measure the bulk volume of each particulate sample fraction. The dust and dirt sample fraction is now ready for analysis; however, the litter must be further processed before it can be accurately sampled.

4. A representative subsample consisting of 20 to 25% of the total amount of litter is homogenized by a combination of techniques including grinding, cutting and blending to prepare it for analysis.

5. The flush fraction is analyzed for total solids by drying a 60 ml portion overnight at 110°C in a tared porcelain crucible. The crucible is cooled for one hour in a desiccator and reweighed.

VOLATILE SOLIDS

Summary

Particulates are heated at 550°C for one hour to determine their weight loss under these conditions.

Equipment

Muffle Oven
Porcelain Crucible, 20 ml Capacity
Analytical Balance
Desiccator

Procedure

1. From 1 to 3 g of litter or dust and dirt solids are weighed into a tared crucible. Residue from the total solids determination is used for the measurement of volatile solids in the flush fraction.

2. Solids are placed in a muffle oven and heated at 550°C for one hour.

3. The crucible is cooled for one hour in a desiccator and reweighed.

BIOCHEMICAL OXYGEN DEMAND

Summary

From 50 to 300 mg of litter and dust and dirt and from 20 to 50 ml of flush are taken for BOD determinations following procedures in Standard Methods (a). An oxygen sensitive electrode is used for dissolved oxygen measurements.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 489, (1971).

CHEMICAL OXYGEN DEMAND

Summary

From 30 to 200 mg of litter and dust and dirt and 20 ml of flush are taken for COD measurements as described in Standard Methods (a) except than 20 ml, rather than 10 ml, of 0.25 N dicromate are used for oxidation of particulate samples.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 495, (1971).

GREASE, PETROLEUM AND N-PARAFFINS

Summary

Grease is determined gravimetrically in roadway samples after extraction with n-hexane. Grease is characterized by isolation of a petroleum and then an n-paraffin fraction using column chromatographic techniques.

Apparatus and Equipment

Soxhlet Extraction Apparatus Equipped with 125 ml Round Bottom Flask
Electric Heating Mantle Regulated with a Variable Transformer
Buchner Funnel and 1 Liter Vacuum Filtration Flask
Filtered Compressed Air Line
Distillation Apparatus
Chromatography Columns, 50 cm x 10 mm I.D.
Round Bottom Flasks, 125 ml
Drying Oven
Desiccator
Analytical Balance

Reagents

Hydrochloric Acid, Conc.
Hydrochloric Acid, 1/10
n-Hexane
Whatman No. 40 Filter Paper
Hyflo Super-Cel (Johns-Manville Corp.)
Muslin Cloth Disks
Glass Wool
Sodium Chloride
Activated Alumina, 80-200 Mesh, Fisher Scientific Co., Activated for Five Hours at 600°C.
Silica Gel, Grade 922, Davidson Co.

Procedure for Water Flush

1. Acidify to pH 1.0 a 500 ml aliquot of flush water with concentrated hydrochloric acid.

2. Add 0.5 g of Hyflo Super-Cell, 150 g of sodium chloride, and stir for two hours at 4°C.

3. Prepare for filtration of the sample by attaching the one liter filtration flask to a vacuum line, placing the funnel on the flask, and placing the muslin cloth disk overlaid with filter paper in the Buchner funnel. Moisten the filter paper and apply suction.

4. Filter the cold acid sample suspension.

5. Remove the filter paper, fold and carefully place in an extraction thimble and cover with glass wool.

6. Dry the extraction thimble for 30 minute at 103°C.

7. Dry the extraction flask for one hour at 103°C, cool for one hour in a desiccator, and weigh to the nearest 0.0001 g.

8. Place the thimble in the assembled extraction apparatus and extract for four hours with n-hexane at a rate of 20 cycles per hour.

9. Fit the extraction flask to the distillation apparatus and distill off n-hexane using a hot water bath.

10. Remove the extraction flask from the distillation set up and blow off the remaining solvent with filtered air.

11. Dry the extraction flask containing grease for one hour at 103°C, cool for an hour in a desiccator, and reweigh.

Procedure for Dust and Dirt

1. Weigh a 5 to 10 g sample of dust and dirt and add 25 ml of 10% hydrochloric acid.

2. Filter the sample slurry after 15 minutes through Whatman No. 40 paper and wash five times with 100 ml portions of water.

3. Complete the determination of grease in dust and dirt by carrying out steps 5 to 11 under the water flush procedure.

4. Reserve the extracted grease for the grease characterization.

Procedure for Grease Characterization

1. Dissolve the weighed residue from the grease determination in 10 ml of n-hexane.

2. Add this to a chromatographic column packed with 10 ml (12 cm) of alumina and containing glass wool plugs at the top and bottom.

3. Elute the column with seven 10 ml portions of solvent, collecting the solvent in a tared round bottom flask.

4. Attach the tared flask to the distillation apparatus and remove n-hexane on a hot water bath.

5. Remove the flask from the distillation set up and blow off the remaining solvent with filtered air.

6. Dry the flask for one hour at 103°C, cool for one hour in a desiccator, and weigh to the nearest 0.0001 g. This represents the hydrocarbon portion of the grease.

7. Dissolve the hydrocarbon fraction in 10 ml of n-hexane.

8. Add this to a chromatographic column packed with 15 ml (15 cm) of silica gel and containing glass wool plugs at the top and bottom.

9. Elute the column with five 15 ml portions of n-hexane, collecting the solvent in a tared round bottom flask.

10. As before, remove the n-hexane, heat, cool, and reweigh the flask to the nearest 0.0001 g. This represents the n-paraffin fraction of the extracted grease.

TOTAL PHOSPHATE-PHOSPHORUS

Summary

Acid-hydrolyzable phosphate content of dust and dirt and flush samples is measured following a procedure based upon Standard Methods (a).

Apparatus and Reagents

See Standard Methods (a)

Procedure

1. A 0.5 g portion of dust and dirt or a 100 ml portion of flush water is placed into a 250 ml Erlenmeyer flask. Add 100 ml of distilled water to the particulate samples.

2. Add 4 ml of strong acid (300 ml conc. sulfuric acid and 4.0 ml conc. nitric acid per liter) to the flask and boil for 90 minutes keeping the volume between 25 and 50 ml.

3. Dilute the sample to 100 ml in a graduated cylinder and then filter, discarding the first 10 ml of filtrate.

4. Take a 10 to 20 ml portion of filtrate, neutralize to phenolphthalein with 2 N sodium hydroxide and add three drops of excess strong acid. Important - do not take a dust and dirt filtrate aliquot larger than 10 ml or low results will be obtained. Low results will also be obtained without the excess strong acid.

5. Dilute to 50 ml and determine orthophosphate as described in Standard Methods (a).

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 523, (1971).

ORTHOPHOSPHATE, NITRATE AND NITRITE

Summary

Orthophosphate, nitrate and nitrite are measured on filtered flush samples. These ions are dissolved from dust and dirt with a special extraction solution and then measured colorimetrically following procedures in Standard Methods (a)(b)(c).

Apparatus and Reagents

Beaker, 100 ml
Magnetic Stirrer and Stirrer Bar
Extraction Solution - 0.67 ml Conc. Sulfuric Acid, 4.1 ml Conc. Hydrochloric Acid and 10 g of Darco G-60 Carbon Black per Liter
Hydrochloric Acid, 0.2 N
pH Meter

See Standard Methods (a)(b)(c) for other apparatus and reagents.

Procedure

1. Filter flush water and analyze for orthophosphate as described in Standard Methods (a), analyze for nitrate as described in Standard Methods (b) and for nitrate as in Standard Methods (c).

2. Add 25 ml of extraction solution to 5 g of dust and dirt. Stir for 15 minutes, adjust to a pH 2.0 with 0.2 N hydrochloric acid and stir for an additional 15 minutes.

3. Filter the above suspension and analyze filtrate for orthophosphate, nitrate and nitrite.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 530, (1971).

(b) Ibid, p 461.

(c) Ibid, p 240.

TOTAL KJELDAHL NITROGEN

Summary

Kjeldahl nitrogen is measured following a procedure similar to that described in Standard Methods (a).

Apparatus

Kjeldahl Distillation Apparatus, Semimicro
Kjeldahl Flasks, 100 ml and 30 ml
Kjeldahl Digestion Rack
Microburet, 10 ml
Erlenmeyer Flask, 125 ml
Analytical Balance

Reagents

Boric Acid, 3%
40% Sodium Hydroxide - 5% Sodium Thiosulfate Solution
Digestion Mixture - 134 g Potassium Sulfate, 2 g Mercuric Oxide and 200 ml Conc. Sulfuric Acid per Liter
Boiling Chips
Standard 0.01 N Hydrochloric Acid
Mixed Indicator - 100 mg Methyl Red and 50 mg Methylene Blue in 150 ml of 95% Ethanol

Procedure

1. Add 10 ml of digestion mixture and a boiling chip to 50 ml of flush in a 100 ml Kjeldahl flask or 1 g of dust and dirt in a 30 ml Kjeldahl flask.

2. Heat on the digestion rack to fumes of sulfuric acid and for 30 minutes after the digest clears.

3. Cool the digest, add 10 ml of water to the flask and cool again.

4. Transfer the diluted digest to the distillation apparatus using a minimum amount of wash water to complete the transfer.

5. Add 10 ml of the basic thiosulfate mixture and steam distill the liberated ammonia into 5 ml of boric acid containing two drops of mixed indicator.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 468, (1971).

6. Steam distill for three minutes after the indicator changes color, lower the receiving flask and continue the distillation for one additional minute.

7. Titrate the distillate with 0.01 N hydrochloric acid.

CHLORIDE

Summary

Chloride is measured in roadway samples using a mercurimetric titration patterned after Standard Methods (a).

Apparatus

Vacuum Filtration Apparatus
Buret, 10 ml
Beakers, 150 ml

Reagents

0.0141 N Standard Sodium Chloride
0.0141 N Standard Mercuric Nitrate
0.1 N Nitric Acid
Sodium Bicarbonate
0.1 N Sodium Hydroxide
Indicator Solution, 0.5 g S-Diphenylcarbazone and 0.05 g Bromophenol Blue per 100 ml of 95% Ethanol.

Procedure

1. Add 5 g of dust and dirt to 20 ml of distilled water and stir for 30 minutes.

2. Take as the sample 10 ml of filtrate from the above or 20 ml of filtered flush water and dilute to 50 ml.

3. Add 10 mg of sodium bicarbonate and 0.5 ml of indicator. Add 0.1 N nitric acid until the indicator turns yellow.

4. Titrate with the mercuric solution to a reddish-purple end point. The mercury solution is standardized in a similar fashion using 0.0141 N sodium chloride.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 97, (1971).

FECAL COLIFORM AND FECAL STREPTOCOCCUS ORGANISMS

Summary

Fecal coliform and fecal streptococcus organisms are determined in roadway samples using the membrane filter procedures described in Standard Methods (a)(b).

Apparatus and Reagents

See Standard Methods (a)(b).

Procedure

1. Add 0.1 g of dust and dirt to 100 ml of sterile water and mix. Membrane filter portions up to 1 ml of flush water or 10 ml of dust and dirt suspension. Note: It has been shown that amounts of roadway particulates greater than 10 mg per filter will inhibit growth of fecal coliform and fecal streptococcus organisms.

2. Determine fecal coliforms as described in Standard Methods (a).

3. Determine fecal streptococcus organisms following Standard Methods (b).

4. The procedures described above have been verified for use with these samples by the recoveries of known numbers of organisms added to roadway dust and dirt.

(a) Standard Methods for the Examination of Water and Wastewater, 13th Edition, APHA-AWWA-WPCF, p 684,(1971).

(b) Ibid, p 690.

ASBESTOS

Summary

Asbestos fibers in roadway samples are evaluated by phase contrast microscopy using a procedure adapted from a NIOSH method (a).

Apparatus

Heat Systems-Ultrasonics, Inc., Model W185D Sonifier Cell Disruptor Equipped with a Water-Cooled Cup Horn
25 ml Polycarbonate Plastic Sonifier Tubes
Carl Zeiss Phase Contrast Light Microscope
Porton Ocular Reticle
Ocular Micrometer
Millipore Membrane Filter Holder
AAWPO Millipore Membrane Filters, 25 mm Diameter, 0.8 μ Pore Size
Dimethyl Phthalate - Diethyl Oxalate Mounting Medium (1:1)
Stoppered Graduated Cylinder, 100 ml
Glass Microscope Slides 25 x 75 mm and No. 1 1/2 Coverslips

Procedure

1. Weigh 100 mg of dust and dirt into a 25 ml sonifier tube, add 25 ml of water, and sonify for one to two minutes at 100 watts in the water-cooled cup horn.

2. Transfer the suspension to a 100 ml graduated cylinder and dilute to volume.

3. Assemble the membrane filtration apparatus and filter from one to ten ml of well mixed dust and dirt suspension or water flush. As much sample as possible should be filtered in order to obtain maximum sensitivity. The amount must be determined experimentally as counting the filter will be difficult or impossible if too much sample is taken.

4. Place the air dried filter on a microscope slide and add two to three drops of mounting medium. Cover with a coverslip after the filter becomes transparent.

5. Examine the slide using phase-contrast optics under a 40x objective and a 10x eyepiece equipped with a Porton reticle. Count the asbestos fibers in 25 randomly selected fields.

(a) Criteria for a Recommended Standard...Occupational Exposure to Asbestos, U.S. Department of HEW, Public Health Services and Mental Health Administration, National Institute for Occupational Safety and Health, p VII-5, (1972).

6. Asbestos fibers are taken as any refractile particle greater than 5 μ in length and having an aspect ratio (length to width) greater than three.

RUBBER

Summary

The technique of pyrolysis-gas chromatography, utilizing a flame ionization detector to measure the styrene liberated from SBR, is employed for the estimation of rubber in roadway samples.

Apparatus and Reagents

Gas Chromatograph with Flame Ionization Detector
Nitrogen Carrier Gas
Pyrolysis Accessory
Chromatographic Column, 4' x 1/4", 2% Apiezon L on 60/80 Mesh Diatoport 5
Soxhlet Extraction Apparatus
Hexane
Styrene

Procedure

1. Extract approximately 1 g of dust and dirt for one hour with hexane in the Soxhlet extractor.

2. Air dry the extracted dust and dirt and weigh 20 to 25 mg into a sample boat and place in the pyrolysis chamber.

3. Adjust the nitrogen carrier gas flow to 25 ml/minute and the gas chromatographic column to 50°C. Sweep air from the system for five minutes.

4. Pyrolyze the sample for 20 seconds at 640°C.

5. After one minute, program the column temperature to 80°C at 40/minute to elute styrene.

6. Rapidly raise column temperature to 210°C and hold until the column is cleared.

7. Measure the styrene peak height and quantitate using a calibration curve prepared with rubber from a passenger car tire; see Figure F-1.

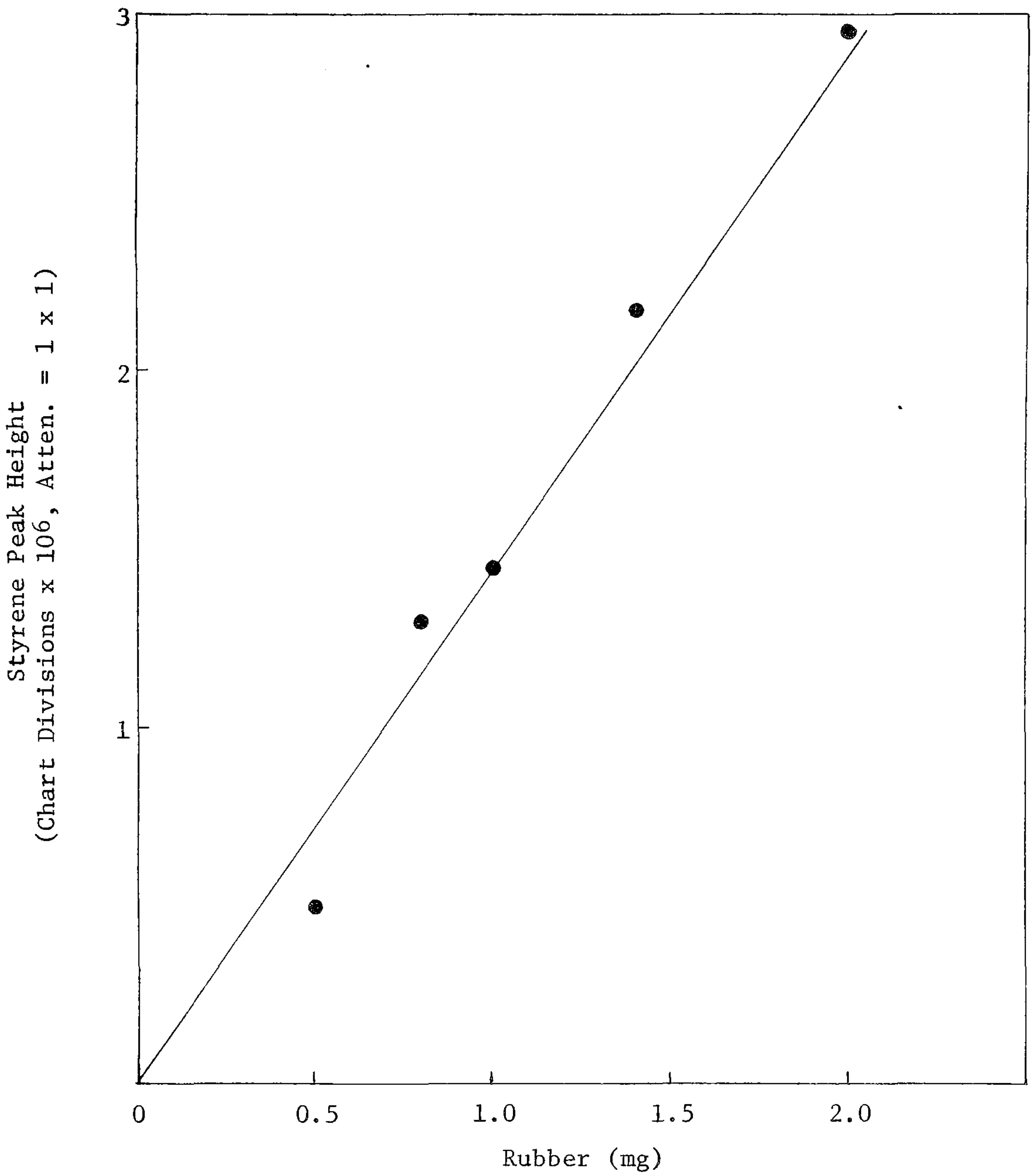


Figure F-1. Standard curve - rubber in dust and dirt

METALS

Summary

Metals are determined in roadway samples by atomic absorption spectrophotometry (AAS) following acid digestion of the samples.

Apparatus

Teflon Beakers, 150 ml
Filter Funnels
Graduated Cylinders
Hot Plate
Analytical Balance
Atomic Absorption Spectrophotometer

Reagents

Deionized Water
Nitric Acid, Concentrated
Hydrofluoric Acid, Concentrated

Procedure

1. From 1 to 5 g of dust and dirt or up to 100 ml of flush are placed in 150 Teflon beaker with 10 ml of nitric acid.

2. Samples are carefully taken just to dryness on a hot plate. A second 10 ml of nitric acid is added and the samples again taken to dryness.

3. Five ml of concentrated hydrofluoric acid is added and the sample heated to dryness to remove silica. A second treatment with hydrofluoric acid is carried out.

4. The samples are heated almost to dryness after addition of 10 ml of nitric acid.

5. The residue is quantitatively transferred to a 50 ml graduated cylinder, diluted to volume and filtered.

6. The filtrate may be analyzed for lead, zinc, nickel, cadmium, chromium, copper and other metals using the standard conditions described in Perkin-Elmer's methods manual (a).

(a) Analytical Methods for Atomic Absorption Spectrophotometry, Perkin-Elmer Corporation, (March 1971).

APPENDIX G

LOCAL CLIMATOLOGICAL DATA

LOCAL CLIMATOLOGICAL DATA

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
DULLES INTERNATIONAL AIRPORT
JULY 1972

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft. Standard time used: EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	87	63	75		64	0	10	1 8	0	0	0	29.49	22	4.2	6.8	14	31			3	3	1
2	89	64	77		67	0	12	1 3 8	0	.37	0	29.62	20	3.1	5.3	14	33			9	7	2
3	88	68	78		68	0	13	1 8	0	.22	0	29.59	23	6.4	7.8	16	24			8	7	3
4	80	65	73		58	0	8	8	0	T	0	29.79	36	5.1	6.6	13	35			7	7	4
5	68	58	63*		59	2	0	1	0	.17	0	29.76	02	7.8	8.3	14	04			10	10	5
6	73	60	67		58	0	2	1 8	0	T	0	29.83	03	1.0	4.6	10	15			10	9	6
7	79	57*	68		58	0	3	2 8	0	0	0	29.88	29	3.3	5.8	10	26			6	6	7
8	78	59	69		59	0	4	3 8	0	.05	0	29.88	20	4.5	6.0	12	24			4	5	8
9	84	62	73		63	0	8	1 8	0	0	0	29.88	17	4.5	6.2	12	18			6	6	9
10	87	65	76		64	0	11	8	0	0	0	29.88	19	9.4	9.6	16	21			3	2	10
11	87	64	76		67	0	11	1 8	0	0	0	29.93	17	6.6	6.8	10	16			3	5	11
12	83	69	76		70	0	11	2 8	0	.04	0	29.86	13	5.7	6.6	14	12			10	10	12
13	88	71	80		71	0	15	1	0	.10	0	29.61	36	4.4	6.8	15	36			6	5	13
14	90	66	78		71	0	13	1 8	0	0	0	29.62	18	5.1	5.5	12	20			2	2	14
15	90	71	81		72	0	16	1 8	0	0	0	29.64	20	9.3	9.6	17	20			1	2	15
16	90	71	81		72	0	16	1 3 8	0	.28	0	29.68	17	3.7	6.0	15	26			9	9	16
17	89	68	79		72	0	14	2	0	0	0	29.79	13	1.1	4.9	8	16			8	7	17
18	89	70	80		73	0	15	2 8	0	0	0	29.83	29	2.6	4.9	8	30			9	7	18
19	92	70	81		74	0	16	1 8	0	0	0	29.85	23	2.3	3.0	7	23			2	4	19
20	93	72	83		75	0	18	1 8	0	0	0	29.84	31	3.0	4.6	9	25			3	6	20
21	94	74	84		76	0	19	1 8	0	0	0	29.78	30	4.3	6.0	12	28			6	5	21
22	95*	75	85*		74	0	20	8	0	0	0	29.71	33	3.5	5.5	12	36			3	4	22
23	94	72	83		74	0	18	1 8	0	0	0	29.61	27	4.9	7.1	14	30			2	3	23
24	93	72	83		70	0	18	8	0	0	0	29.53	27	4.7	6.2	14	30			7	7	24
25	91	72	82		68	0	17	1	0	T	0	29.51	28	6.0	7.9	16	27			6	6	25
26	85	63	74		60	0	9		0	0	0	29.65	33	5.8	7.3	16	30			5	6	26
27	80	68	74		65	0	9		0	.01	0	29.66	35	.5	5.5	9	01			10	10	27
28	82	65	74		64	0	9	8	0	0	0	29.64	01	4.3	5.8	7	04			10	10	28
29	72	64	68		61	0	3	1 8	0	.01	0	29.66	34	1.7	5.5	9	20			10	10	29
30	67	62	65		62	0	0	1 8	0	.22	0	29.75	06	1.8	4.3	9	12			10	10	30
31	80	65	73		67	0	8	1	0	.06	0	29.79	17	2.9	4.9	8	17			10	9	31
	Sum	Sum				Total	Total			Total	Total	For the month.						Total	%	Sum	Sum	
	2637	2065				2	346	Number of days		1.53	0	29.73	24	1.3	6.2	17	20		for	198	199	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date	15	Possible	month	Avg.	Avg.	
	85.1	66.6	75.9		67			≥ .01 inch	11											6.4	6.4	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
10	0	0	0

Season to date	Heating	Cooling
Total	2	503
Dep.		

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	3
Heavy fog X	4
Clear	9
Partly cloudy	9
Cloudy	13

Greatest in 24 hours and dates: Precipitation	Dates	Snow, ice pellets	Greatest depth on ground of snow, ice pellets or ice and date
.48	2- 3	0	0

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
DULLES INTERNATIONAL AIRPORT
AUGUST 1972

Latitude 38° 57′ N   Longitude 77° 27′ W   Elevation (ground) 290 ft.   Standard time used: EASTERN   WBAN #93738

Weather types on dates of occurrence: 1 Fog; 2 Heavy fog X; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow

Date	Temperature °F Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65° Heating	Cooling	Weather types on dates of occurrence	Snow, ice pellets or ice on ground at 07AM In.	Precipitation Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 323 feet m.s.l.	Wind Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Sunshine Hours and tenths	Percent of possible	Sky cover Tenths Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	88	60	74		64	0	9	1 8	0	0	0	29.78	25	3.1	4.5	9	27			6	5	1
2	87	66	77		67	0	12	1 8	0	.01	0	29.67	18	5.8	6.3	12	20			10	9	2
3	90	67	79		70	0	14	1 3 8	0	.36	0	29.59	20	4.2	6.2	18	30			10	8	3
4	83	64	74		68	0	9	1 8	0	.50	0	29.71	35	4.6	7.5	16	36			10	9	4
5	80	58	69		58	0	4		0	0	0	29.85	01	4.6	6.2	13	04			7	6	5
6	83	56	70		62	0	5	1 8	0	0	0	29.71	19	5.2	6.5	15	24			5	4	6
7	87	68	78		69	0	13	1 8	0	T	0	29.44	20	9.0	9.5	16	18			7	8	7
8	85	62	74		63	0	9		0	0	0	29.51	26	3.2	5.3	15	30			2	3	8
9	87	62	75		62	0	10	1 8	0	0	0	29.58	26	5.3	8.5	15	31			9	6	9
10	78	52	65		53	0	0		0	0	0	29.88	33	5.1	7.1	16	35			3	3	10
11	80	47*	64		56	1	0	1	0	0	0	29.91	18	6.0	6.8	14	19			5	3	11
12	86	60	73		65	0	8	1 8	0	0	0	29.77	20	6.1	6.9	12	19			6	7	12
13	86	66	76		69	0	11	1 8	0	.07	0	29.75	34	3.0	4.9	14	01			7	7	13
14	89	62	76		66	0	11	2 8	0	0	0	29.74	27	2.4	3.5	10	32			4	4	14
15	82	56	69		61	0	4	1 8	0	0	0	29.80	05	4.1	6.5	17	36			8	6	15
16	77	49	63*		54	2	0		0	T	0	29.92	17	4.5	5.8	13	18			7	6	16
17	71	62	67		63	0	2	1 8	0	.42	0	29.68	15	5.4	6.9	13	17			10	10	17
18	87	65	76		70	0	11	2 8	0	T	0	29.61	36	2.6	5.5	10	36			7	8	18
19	87	62	75		66	0	10	1 8	0	0	0	29.65	34	5.0	6.2	14	01			5	5	19
20	86	58	72		59	0	7		0	0	0	29.77	01	4.9	5.9	13	36			0	0	20
21	86	54	70		60	0	5	1	0	0	0	29.78	17	3.4	5.2	12	13			2	1	21
22	86	59	73		64	0	8	1	0	0	0	29.67	17	7.0	7.3	14	18			8	5	22
23	89	63	76		67	0	11	1 8	0	0	0	29.65	17	7.0	7.3	13	17			4	3	23
24	93	64	79		70	0	14	2 8	0	0	0	29.67	18	3.5	4.2	10	18			2	2	24
25	95*	67	81		71	0	16	2 8	0	0	0	29.69	19	3.9	4.2	15	23			5	5	25
26	93	69	81*		70	0	16	1 3 8	0	.18	0	29.65	33	1.0	5.6	20	36			9	9	26
27	89	70	80		71	0	15	1 3	0	.55	0	29.54	21	7.7	10.1	16	18			7	7	27
28	83	64	74		67	0	9	1	0	0	0	29.56	27	4.3	5.5	12	27			10	9	28
29	87	60	74		63	0	9		0	0	0	29.63	30	1.3	3.9	9	31			1	1	29
30	87	61	74		61	0	9		0	0	0	29.76	02	5.8	7.3	14	01			1	0	30
31	85	59	72		59	0	7	1 8	0	0	0	29.86	04	2.5	5.8	10	10			5	4	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	2652	1892				3	268	Number of days		2.09	0	29.70	21	1.4	6.2	20	36			182	163	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date.	26	Possible		Avg.	Avg.	
	85.5	61.0	73.3		64			≥ .01 inch	7											5.9	5.3	

Number of days				Season to date	
Maximum Temp		Minimum Temp		Total	Total
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	5	771
4	0	0	0	Dep.	Dep.

Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	3
Heavy fog X	4
Clear 7	Partly cloudy 15 Cloudy 9

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
.55	27	0		0	

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A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
WASHINGTON NATIONAL AIRPORT
AUGUST 1972

Latitude 38° 51 N Longitude 77° 02′ W Elevation (ground) 10 ft. Standard time used EASTERN WBAN #13743

Weather types on dates of occurrence: 1 Fog; 2 Heavy fog x; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow

Date	Temperature °F Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65° Heating	Cooling	Weather types on dates of occurrence	Snow, ice pellets or ice on ground at 07AM In	Precipitation Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev. 65 feet m.s.l.	Wind Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Sunshine Hours and tenths	Percent of possible	Sky cover Tenths Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	88	66	77	-1	66	0	12	1 8	0	0	0	30.04	24	3.5	6.2	10	NW	13.4	94	4	4	1
2	87	69	78	0	68	0	13	1 8	0	T	0	29.95	19	6.3	6.6	10	S	5.7	40	10	9	2
3	88	72	80	2	71	0	15	1 8	0	.02	0	29.86	21	6.2	6.8	12	SW	5.1	36	10	8	3
4	84	67	76	-2	67	0	11	8	0	.34	0	29.97	01	6.6	8.3	17	N	1.5	11	10	9	4
5	79	63	71	-7	58	0	6		0	0	0	30.11	05	7.1	8.6	13	N	11.5	82	6	7	5
6	84	66	75	-3	65	0	.10		0	0	0	29.99	17	5.7	6.6	11	S	10.6	76	5	5	6
7	87	72	80	2	70	0	15	3 8	0	.23	0	29.72	21	12.5	12.8	18	SW	5.7	41	7	7	7
8	84	67	76	-2	64	0	11		0	0	0	29.78	31	3.2	7.6	13	NW	11.2	80	2	3	8
9	88	65	77	-1	64	0	12	1 8	0	0	0	29.84	27	4.2	8.6	18	NW	10.2	73	8	5	9
10	78	60	69	-9	51	0	4		0	0	0	30.14	33	7.6	8.6	16	NW	12.8	92	3	2	10
11	79	57	68	-10	56	0	3		0	0	0	30.19	19	4.6	5.8	12	S	9.6	70	5	3	11
12	83	66	75	-3	64	0	10		0	0	0	30.05	19	8.9	9.2	11	S	11.1	80	7	7	12
13	86	69	78	0	68	0	13	3 8	0	1.72	0	30.02	12	3.2	6.9	20	SE	3.4	25	10	8	13
14	87	66	77	0	68	0	12	1 8	0	0	0	30.01	22	1.5	4.5	8	N	12.4	91	4	3	14
15	80	64	72	-5	62	0	7	8	0	0	0	30.06	07	5.9	10.2	18	NE	4.4	32	8	6	15
16	78	57*	68	-9	53	0	3		0	0	0	30.19	13	3.5	5.3	11	E	12.7	93	6	5	16
17	70	64	67*	-10	62	0	2	1 8	0	.28	0	29.96	16	5.2	7.3	13	S	0.0	0	10	10	17
18	85	68	77	0	69	0	12	1 8	0	.05	0	29.87	36	2.7	6.6	8	S	6.8	50	7	8	18
19	86	70	78	1	66	0	13	8	0	0	0	29.92	35	6.2	8.5	12	NE	·11.2	82	4	4	19
20	85	66	76	0	60	0	11		0	0	0	30.03	05	4.7	6.6	9	NE	12.9	96	0	1	20
21	84	65	75	-1	62	0	10	8	0	0	0	30.05	19	3.8	5.6	9	S	11.0	81	2	2	21
22	84	64	74	-2	64	0	9	8	0	0	0	29.95	19	7.1	7.5	10	SE	12.4	93	6	4	22
23	87	70	79	3	68	0	14	8	0	0	0	29.92	18	7.3	7.6	10	S	10.7	80	3	3	23
24	90	72	81	5	72	0	16	1 8	0	0	0	29.94	18	5.4	5.6	9	S	11.5	86	2	3	24
25	91	74	83	8	72	0	18	8	0	0	0	29.96	19	6.5	6.8	10	S	8.0	60	5	5	25
26	92*	75	84*	9	72	0	19	3 8	0	.03	0	29.92	19	5.0	6.5	13	W	5.9	44	9	8	26
27	87	74	81	6	71	0	16	8	0	.15	0	29.82	21	10.7	12.8	18	SW	6.2	47	6	6	27
28	84	70	77	2	65	0	12	1 8	0	T	0	29.83	29	4.5	6.3	12	N	6.4	48	10	10	28
29	86	66	76	1	63	0	11	8	0	0	0	29.90	32	4.1	5.2	10	N	11.7	89	1	1	29
30	87	69	78	4	62	0	13	8	0	0	0	30.02	02	6.3	7.9	12	NE	10.5	80	1	1	30
31	85	70	78	4	61	0	13	1 8	0	0	0	30.13	08	4.9	6.5	10	E	10.0	76	2	4	31
	Sum	Sum				Total	Total			Total	Total	For the month						Total	% for month	Sum	Sum	
	2623	2083				0	346	Number of days		2.82	0	29.97	19	1.7	7.4	20	SE	276.5		173	161	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date.	13	Possible		Avg.	Avg.	
	84.6	67.2	75.9	-0.6	65	0		≥ .01 inch	8	-2.08								423.0	65	5.6	5.2	

Season to date Total	Total
0	981
Dep.	Dep.
0	

Number of days

Maximum Temp ≥ 90° ‡	Maximum Temp ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
3	0	0	0

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	3
Heavy fog X	0

Clear 9 Partly cloudy 13 Cloudy 9

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
1.72	13	0		0	

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LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
DULLES INTERNATIONAL AIRPORT
SEPTEMBER 1972

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft. Standard time used: EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg station pressure In. Elev. 323 feet m.s.l	Wind: Resultant direction	Resultant speed m.p.h	Average speed m.p.h	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	78	60	69		61	0	4	1 8	0	T	0	29.79	02	4.6	5.2	12	05			10	10	1
2	78	65	72		63	0	7		0	.19	0	29.70	35	6.5	7.1	16	36			10	10	2
3	85	59	72		65	0	7	1 8	0	T	0	29.63	31	3.0	5.2	10	32			6	6	3
4	77	54	66		61	0	1	1 8	0	.08	0	29.62	34	5.6	6.5	12	01			7	6	4
5	71	50	61		54	4	0		0	0	0	29.64	01	1.2	3.7	8	02			9	7	5
6	81	45	63		53	2	0	1	0	0	0	29.72	03	3.4	4.6	12	05			0	1	6
7	84	48	66		55	0	1	1 8	0	0	0	29.75	35	1.3	3.9	12	36			1	0	7
8	86	50	68		58	0	3	2 8	0	0	0	29.69	30	1.3	2.7	8	01			1	2	8
9	85	57	71		60	0	6	1 8	0	0	0	29.69	35	6.3	7.8	18	34			7	6	9
10	77	45	61		47	4	0		0	0	0	29.97	35	3.1	7.2	15	06			0	1	10
11	77	44	61		53	4	0		0	0	0	29.91	19	6.2	6.8	15	21			10	7	11
12	80	62	71		66	0	6	1 8	0	.01	0	29.77	19	4.8	5.3	13	24			10	10	12
13	90	65	78		68	0	13	1 8	0	0	0	29.70	22	5.5	6.8	14	24			9	8	13
14	92	63	78		66	0	13	8	0	.22	0	29.55	26	4.4	8.1	23	36			8	8	14
15	79	56	68		57	0	3		0	0	0	29.65	36	2.2	5.0	13	01			1	3	15
16	88	55	72		59	0	7	1 8	0	0	0	29.58	22	3.4	5.5	12	25			3	4	16
17	92*	57	75		64	0	10	1 8	0	0	0	29.66	18	7.1	7.6	14	18			3	4	17
18	86	66	76		71	0	11	2 8	0	.12	0	29.74	18	4.8	6.0	12	18			10	8	18
19	82	62	72		63	0	7	1 8	0	0	0	29.80	34	7.2	9.4	20	36			4	3	19
20	67	55	61		54	4	0		0	0	0	29.95	03	9.3	10.5	17	04			10	9	20
21	62	58	60		57	5	0	1 8	0	.01	0	29.80	36	11.7	11.9	17	36			10	10	21
22	81	57	69		57	0	4	1 8	0	T	0	29.76	34	7.0	7.2	16	36			4	5	22
23	72	41*	57*		48	8	0		0	0	0	29.96	13	2.4	6.8	13	14			7	6	23
24	74	60	67		60	0	2	1 8	0	.03	0	29.91	17	7.5	8.2	14	20			9	10	24
25	83	59	71		66	0	6	2 8	0	0	0	29.87	19	2.1	4.0	9	21			10	10	25
26	91	65	78*		67	0	13	1 8	0	T	0	29.79	20	6.1	7.1	10	23			8	9	26
27	76	68	72		69	0	7	1 8	0	.09	0	29.78	21	2.6	4.0	9	36			10	10	27
28	73	63	68		64	0	3	1 8	0	0	0	29.86	06	6.3	9.4	14	01			10	10	28
29	68	62	65		64	0	0	1 8	0	.01	0	29.60	15	4.9	6.6	10	18			10	10	29
30	70	45	58		55	7	0	1	0	.64	0	29.35	27	6.1	10.6	25	30			10	9	30
	Sum	Sum				Total	Total			Total	Total	For the month.						Total	%	Sum	Sum	
	2385	1696				38	134	Number of days		1.40	0	29.74	32	.9	6.7	25	30		for	207	202	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date:	30	Possible	month	Avg.	Avg.	
	79.5	56.5	68.0		60			≥ .01 inch	10											6.9	6.7	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	43	905
4	0	0	0	Dep.	Dep.

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	3

Clear 7 Partly cloudy 6 Cloudy 17

Greatest in 24 hours and dates				Greatest depth on ground of snow, ice pellets or ice and date
Precipitation		Snow, ice pellets		
.64	30	0		0

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
WASHINGTON NATIONAL AIRPORT
SEPTEMBER 1972

Latitude 38° 51' N Longitude 77° 02' W Elevation (ground) 10 ft Standard time used: EASTERN WBAN #13743

Weather types on dates of occurrence: 1 Fog; 2 Heavy fog X; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	82	67	75	1	61	0	10		0	T	0	30.06	07	3.4	6.5	17	NW	1.9	15	10	10	1
2	77	68	73	-1	65	0	8	8	0	.12	0	29.96	02	8.9	9.6	13	N	0.3	2	10	9	2
3	85	66	76	3	65	0	11	8	0	0	0	29.89	32	5.4	7.2	11	NW	7.4	57	2	4	3
4	76	62	69	-4	60	0	4	8	0	.07	0	29.89	34	7.6	8.3	14	NW	4.9	38	7	6	4
5	72	59.	66	-7	52	0	1		0	0	0	29.91	02	2.0	6.2	9	NE	2.4	19	10	7	5
6	81	55	68	-5	54	0	3		0	0	0	29.99	04	3.2	6.3	9	E	12.5	98	0	0	6
7	85	56	71	-1	57	0	6	8	0	0	0	30.02	07	1.3	4.2	9	SE	11.3	88	1	1	7
8	86	60	73	1	59	0	8	8	0	0	0	29.96	10	1.1	3.9	9	SE	11.3	88	2	3	8
9	85	64	75	3	59	0	10	8	0	0	0	29.94	01	8.0	9.1	17	N	4.8	38	7	5	9
10	77	57	67	-4	46	0	2		0	0	0	30.24	04	5.5	8.5	14	NE	12.5	98	0	0	10
11	75	54	65	-6	53	0	0		0	0	0	30.19	20	7.3	7.8	14	S	3.7	29	10	8	11
12	79	65	72	1	65	0	7	1 8	0	.06	0	30.05	21	6.6	7.2	13	SW	0.1	1	10	10	12
13	89	69	79	8	70	0	14	1 8	0	0	0	29.96	19	5.3	5.5	10	SW	2.1	17	10	9	13
14	91	66	79	8	68	0	14	8	0	.26	0	29.81	20	3.8	8.9	31	NW	6.9	55	6	6	14
15	80	62	71	1	57	0	6		0	0	0	29.92	33	4.8	6.9	10	N	11.3	90	2	2	15
16	87	63	75	5	63	0	10	1 8	0	0	0	29.85	19	6.0	6.6	10	SW	9.4	76	4	4	16
17	91*	68	80*	11	69	0	15	1 8	0	0	0	29.94	19	7.8	8.1	10	S	10.3	83	2	5	17
18	83	69	76	7	70	0	11	1 3 8	0	.10	0	30.02	19	6.7	7.3	11	S	0.8	7	10	8	18
19	83	64	74	5	63	0	9	1 8	0	0	0	30.05	35	9.1	12.9	19	N	6.6	54	5	3	19
20	67	61	64	-5	53	1	0		0	0	0	30.20	03	11.6	12.5	17	N	0.0	0	10	9	20
21	64	60	62	-6	58	3	0	1 8	0	.04	0	30.06	02	11.6	12.7	16	N	0.0	0	10	10	21
22	82	61	72	4	57	0	7	1	0	.01	0	30.02	33	9.1	9.5	14	NE	8.2	67	5	5	22
23	74	53	64	-3	47	1	0		0	0	0	30.23	06	6.2	8.3	15	NE	9.8	81	8	6	23
24	76	60	68	1	59	0	3	8	0	.06	0	30.19	19	6.4	6.6	12	SW	0.6	5	10	9	24
25	83	62	73	6	66	0	8	1 8	0	0	0	30.14	18	4.1	4.2	9	S	5.0	41	7	7	25
26	89	69	79	13	68	0	14	1 8	0	0	0	30.07	19	8.6	8.9	12	SW	7.5	63	6	7	26
27	76	71	74	8	69	0	9	1 8	0	.17	0	30.05	20	5.2	6.5	8	NE	0.0	0	10	10	27
28	73	63	68	2	63	0	3	1 8	0	T	0	30.13	06	9.9	10.5	15	E	0.0	0	10	10	28
29	70	63	67	2	63	0	2	1	0	T	0	29.88	13	3.8	8.1	10	E	0.0	0	10	10	29
30	73	50*	62*	-3	57	3	0	1	0	.38	0	29.61	27	8.7	14.4	24	NW	0.4	3	10	9	30
	Sum 2391	Sum 1867				Total 8	Total 195			Total 1.27	Total 0	For the month: 30.01	01	.7	8.1	31	NW	Total 152.0	% for month	Sum 204	Sum 192	
	Avg. 79.7	Avg. 62.2	Avg 71.0	Dep. 1.3	Avg 61	Dep -25	Dep.			Dep. -2.56						Date 14		Possible 373.2	41	Avg 6.8	Avg 6.4	

Number of days			
Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
2	0	0	0

Season to date	
Heating Total	Cooling Total
6	1176
Dep. -25	Dep

Number of days	
Precipitation ≥ .01 inch	10
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	1
Heavy fog X	0
Clear	7
Partly cloudy	8
Cloudy	15

Greatest in 24 hours and dates: Precipitation	Date	Snow, ice pellets	Greatest depth on ground of snow, ice pellets or ice and date
.38	29-30	0	0

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LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
OCTOBER 1972

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft Standard time used EASTERN WBAN #93738

Weather types on dates of occurrence: 1 Fog; 2 Heavy fog X; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In.	Snow, ice pellets In	Avg. station pressure In. Elev 323 feet m s l	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	65	37	51		41	14	0		0	0	0	29.69	35	4.0	4.5	12	36			3	1	1
2	72	37	55		44	10	0	1	0	0	0	29.94	10	.9	1.9	7	14			0	0	2
3	73	39	56		46	9	0	1	0	0	0	30.06	13	2.8	5.2	12	14			2	2	3
4	73	44	59		53	6	0	2	0	0	0	30.04	09	3.8	6.3	12	15			9	8	4
5	72	59	66		62	0	1	1	0	.02	0	29.85	07	10.1	10.8	17	08			10	10	5
6	72	63	68*		64	0	3	1	0	.68	0	29.51	06	8.2	10.2	16	08			10	10	6
7	69	51	60		54	5	0	1	0	.27	0	29.17	33	13.8	14.1	22	32			10	8	7
8	77*	45	61		43	4	0		0	0	0	29.28	28	9.4	11.2	20	29			0	2	8
9	63	34	49		37	16	0		0	0	0	29.76	31	7.4	9.1	17	29			2	3	9
10	60	31	46		32	19	0		0	0	0	30.28	02	2.4	3.3	12	03			2	2	10
11	65	28	47		38	18	0		0	T	0	30.30	14	4.2	4.5	12	14			3	4	11
12	71	43	57		53	8	0		0	T	0	29.87	24	3.0	6.2	12	32			9	9	12
13	67	47	57		48	8	0		0	0	0	29.73	36	5.8	7.6	14	01			6	6	13
14	71	44	58		50	7	0		0	0	0	29.68	18	2.9	5.0	14	20			5	7	14
15	65	33	49		35	16	0		0	0	0	29.82	32	7.2	10.2	21	34			1	3	15
16	63	35	49		45	16	0		0	0	0	29.60	20	11.5	11.7	23	19			9	8	16
17	76	47	62		46	3	0	1 8	0	0	0	29.48	31	3.2	9.5	18	36			3	3	17
18	51	40	46		35	19	0	1	0	.15	0	29.93	09	3.4	6.3	16	35			10	9	18
19	42	28	35		36	30	0	1	0	.69	.1	29.94	35	9.3	9.9	17	36			10	8	19
20	49	20*	35*		25	30	0		0	0	0	30.21	33	3.9	6.5	13	02			0	0	20
21	55	22	39		29	26	0		0	0	0	30.17	17	4.6	6.3	14	13			9	9	21
22	64	40	52		42	13	0		0	T	0	29.96	18	6.7	7.9	14	18			9	9	22
23	66	36	51		49	14	0	2	0	.02	0	29.69	26	2.0	5.2	10	26			10	9	23
24	73	48	61		52	4	0	2	0	0	0	29.65	35	4.9	8.5	18	36			9	9	24
25	58	35	47		40	18	0		0	0	0	29.74	34	8.5	9.1	16	36			8	8	25
26	56	26	41		33	24	0	1	0	0	0	29.82	27	.5	4.3	10	36			0	1	26
27	63	26	45		38	20	0	2 8	0	T	0	29.91	08	3.6	6.3	10	14			5	5	27
28	59	48	54		52	11	0	1	0	1.61	0	29.63	35	5.6	7.1	14	04			10	9	28
29	68	48	58		52	7	0	2	0	0	0	29.58	29	3.1	7.8	22	31			9	9	29
30	61	38	50		41	15	0		0	0	0	29.89	34	5.3	7.1	14	36			3	4	30
31	47	34	41		36	24	0		0	T	0	30.03	05	3.7	5.6	9	04			10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1986	1206				414	4	Number of days		3.44	.1	29.81	35	1.7	7.4	23	19			186	185	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date:	16	Possible		Avg.	Avg.	
	64.1	38.9	51.5		44			≥ .01 inch	7											6.0	6.0	

Number of days				Season to date			
Maximum Temp.		Minimum Temp.		Total	Total	Snow, ice pellets ≥ 1.0 inch	0
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	457	909	Thunderstorms	0
0	0	7	0	Dep.	Dep.	Heavy fog X	5

Clear 12 Partly cloudy 3 Cloudy 16

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
1.61	28	.1	19	0	

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LOCAL CLIMATOLOGICAL DATA

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
OCTOBER 1972

Latitude 38° 51′ N Longitude 77° 02′ W Elevation (ground) 10 ft. Standard time used: EASTERN WBAN #13743

Column groups: Temperature °F (2–7B; Degree days Base 65° = 7A–7B); Weather types on dates of occurrence (8); Snow, ice pellets or ice on ground at 07AM In. (9); Precipitation (10–11); Avg station pressure In. Elev 65 feet m s l (12); Wind (13–17; Fastest mile = 16–17); Sunshine (18–19); Sky cover Tenths (20–21).

Weather types: 1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow

Date	Maximum	Minimum	Average	Departure from normal	Average dew point	Heating	Cooling	Weather types	Snow, ice pellets or ice on ground at 07AM In.	Water equivalent In.	Snow, ice pellets In.	Avg station pressure In.	Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Sunshine Hours and tenths	Percent of possible	Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	67	46	57	-7	41	8	0		0	0	0	29.96	34	6.2	7.5	13	N	10.5	89	1	1	1
2	72	45	59	-5	44	6	0	8	0	0	0	30.21	36	1.1	3.9	10	SE	11.8	100	0	0	2
3	74	48	61	-3	49	4	0	8	0	0	0	30.34	11	2.2	4.6	10	SE	11.6	99	1	1	3
4	73	53	63	0	56	2	0	1 8	0	0	0	30.31	09	6.6	7.8	12	E	2.8	24	8	7	4
5	73	62	68	5	61	0	3		0	.06	0	30.12	06	13.1	13.2	19	SE	0.0	0	10	10	5
6	73	65	69*	6	63	0	4	1	0	.69	0	29.77	06	12.1	12.7	17	E	0.0	0	10	10	6
7	69	52	61	-1	54	4	0	1	0	.14	0	29.41	33	15.6	16.0	26	N	0.4	3	10	8	7
8	76	50	63	1	41	2	0		0	0	0	29.55	29	8.2	10.9	18	N	11.5	100	0	1	8
9	64	46	55	-7	35	10	0		0	0	0	30.02	32	9.8	10.2	21	N	10.0	87	2	3	9
10	61	41	51	-10	31	14	0		0	0	0	30.55	02	2.8	6.2	13	E	11.3	99	2	1	10
11	67	38	53	-8	41	12	0	1 8	0	0	0	30.57	20	3.8	5.2	9	W	11.0	96	3	3	11
12	69	52	61	0	53	4	0	8	0	.01	0	30.14	21	6.3	7.5	11	SW	1.9	17	10	9	12
13	67	53	60	0	46	5	0	8	0	0	0	30.00	34	6.0	7.5	17	N	7.9	70	6	5	13
14	69	52	61	1	49	4	0	8	0	0	0	29.96	15	2.9	5.5	9	W	5.8	51	6	8	14
15	64	41	53	-7	35	12	0		0	0	0	30.09	33	9.2	11.4	27	N	11.2	100	0	2	15
16	60	43	52	-7	45	13	0	8	0	0	0	29.89	21	11.4	11.5	21	SW	0.3	3	10	9	16
17	79*	51	65	6	46	0	0	8	0	0	0	29.75	31	7.3	10.9	19	NE	9.2	82	4	3	17
18	53	44	49	-10	31	16	0	1	0	.02	0	30.21	06	6.9	9.4	17	NE	0.6	5	10	9	18
19	45	34	40*	-18	37	25	0	1	0	.59	T	30.21	36	11.5	12.8	18	NE	0.0	0	10	8	19
20	51	31*	41	-17	24	24	0		0	0	0	30.49	35	7.3	8.9	13	NE	11.0	100	0	0	20
21	55	32	44	-14	30	21	0	8	0	0	0	30.46	19	3.2	6.0	9	SW	5.9	54	9	8	21
22	64	49	57	0	43	8	0		0	T	0	30.25	19	6.2	6.5	9	SW	3.7	34	8	8	22
23	73	47	60	3	53	5	0	8	0	.02	0	29.97	19	4.9	6.2	13	SW	3.2	29	9	9	23
24	75	57	66	9	54	0	1	1 8	0	0	0	29.91	35	5.2	8.1	17	NE	4.8	44	9	9	24
25	61	44	53	-3	38	12	0		0	0	0	30.01	35	10.6	10.8	16	NE	4.6	43	8	8	25
26	58	40	49	-7	34	16	0	8	0	0	0	30.11	06	1.7	5.2	11	SE	10.8	100	0	1	26
27	64	37	51	-4	40	14	0	1 8	0	T	0	30.19	06	4.1	5.2	11	SE	8.5	79	5	5	27
28	65	54	60	5	54	5	0	1	0	2.03	0	29.90	35	4.9	6.5	10	E	0.0	0	10	9	28
29	71	54	63	8	53	2	0	2 8	0	0	0	29.84	30	4.9	9.4	25	NW	2.7	25	8	8	29
30	63	46	55	1	40	10	0		0	0	0	30.15	34	8.6	9.9	12	N	10.2	96	2	3	30
31	49	40	45	-9	34	20	0	8	0	T	0	30.31	05	6.3	7.2	11	NE	0.6	6	10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	2024	1447				278	8	Number of days		3.56	T	30.08	35	2.8	8.5	27	N	183.8		181	176	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep						Date:	15	Possible		Avg.	Avg.	
	65.3	46.7	56.0	-3.0	44	61		≥ .01 inch	8	0.49								346.7	53	5.8	5.7	

Season to date	
Total	Total
286	1184
Dep.	Dep
36	

Number of days

Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
0	0	2	0

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	1

Clear 11 Partly cloudy 4 Cloudy 16

Greatest in 24 hours and dates

Precipitation		Snow, ice pellets	
2.03	27-28	T	19

Greatest depth on ground of snow, ice pellets or ice and date: 0

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LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
NOVEMBER 1972

Latitude 38° 57′ N Longitude 77 27′ W Elevation (ground) 290 ft Standard time used: EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In.	Snow, ice pellets In	Avg. station pressure In. Elev. 323 feet m s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	52	43	48		47	17	0	1	0	.52	0	29.93	12	5.2	6.0	10	15			10	10	1
2	69	52	61		57	4	0	1 8	0	T	0	29.66	20	10.0	10.9	17	22			10	10	2
3	72*	49	61*		50	4	0		0	T	0	29.57	30	6.4	10.4	18	30			5	7	3
4	64	48	56		45	9	0		0	0	0	29.67	33	7.5	8.2	14	32			9	9	4
5	60	33	47		38	18	0		0	0	0	29.89	34	6.4	7.9	17	36			2	1	5
6	56	29	43		34	22	0		0	0	0	30.12	13	.9	5.0	10	15			0	0	6
7	62	28	45		42	20	0		0	.02	0	29.85	18	3.3	6.2	15	20			7	7	7
8	60	52	56		48	9	0	1	0	1.29	0	29.31	30	15.8	19.0	31	30			10	10	8
9	56	38	47		40	18	0		0	0	0	29.62	32	14.4	14.7	26	31			5	5	9
10	56	26	41		37	24	0	8	0	0	0	29.73	15	2.9	6.9	10	15			1	3	10
11	61	43	52		46	13	0	1 8	0	T	0	29.64	31	4.8	6.9	16	30			8	7	11
12	57	33	45		38	20	0		0	0	0	29.88	34	4.0	6.3	12	01			2	2	12
13	60	29	45		42	20	0	2 8	0	.03	0	29.80	14	4.4	7.1	12	14			9	7	13
14	56	44	50		51	15	0	1 3	0	1.90	0	29.26	05	4.5	7.8	17	32			10	9	14
15	51	29	40		30	25	0		0	0	0	29.59	32	14.4	14.7	24	30			7	5	15
16	42	20	31		26	34	0		0	0	0	29.85	04	2.0	4.6	9	19			8	7	16
17	41	27	34		32	31	0		0	0	0	29.71	36	5.4	6.3	12	01			10	8	17
18	49	23	36		30	29	0		0	0	0	29.88	36	3.6	5.8	12	35			4	4	18
19	40	32	36		36	29	0	1 8	0	1.33	0	29.85	04	5.2	7.6	14	04			10	10	19
20	50	32	41		35	24	0	1	0	.01	0	29.58	32	9.5	9.9	18	31			8	6	20
21	44	25	35		27	30	0		0	0	0	29.84	32	7.1	7.8	14	32			8	6	21
22	36	23	30		30	35	0	1	T	.06	.6	29.77	21	2.6	6.3	10	20			10	8	22
23	37	17	27*		23	38	0		T	T	T	29.87	30	1.7	5.8	9	32			8	4	23
24	48	19	34		22	31	0		0	0	0	29.82	24	4.8	6.3	14	29			0	0	24
25	43	17*	30		28	35	0	1 4	0	.57	T	29.61	18	4.1	7.8	14	12			10	8	25
26	53	35	44		40	21	0	1	0	.69	0	29.00	25	3.4	8.3	15	26			7	8	26
27	53	33	43		31	22	0		0	0	0	29.48	20	12.0	12.4	20	20			0	3	27
28	51	36	44		35	21	0		0	T	0	29.74	23	4.4	10.2	18	31			10	8	28
29	43	21	32		25	33	0		0	0	0	30.07	36	2.5	6.2	14	02			4	4	29
30	33	27	30		31	35	0	1 4 6	0	.67	T	29.74	35	7.1	8.1	16	36			10	10	30
	Sum 1555	Sum 963				Total 686	Total 0	Number of days		Total 7.09	Total .6	For the month: 29.71	31	2.7	8.4	31	30	Total	% for month	Sum 202	Sum 186	
	Avg. 51.8	Avg. 32.1	Avg. 42.0	Dep.	Avg. 36	Dep.	Dep.	Precipitation ≥ .01 inch 11		Dep.						Date:	08	Possible		Avg. 6.7	Avg. 6.2	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
0	0	17	0

Season to date	Heating	Cooling
Total	1143	909
Dep.		

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	1
Heavy fog X	1

Clear 6 Partly cloudy 7 Cloudy 17

Greatest in 24 hours and dates: Precipitation	Dates	Snow, ice pellets	Dates	Greatest depth on ground of snow, ice pellets or ice and date	Date
1.93	13-14	.6	22	T	23+

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
NOVEMBER 1972

Latitude 38° 51′ N Longitude 77° 02′ W Elevation (ground) 10 ft Standard time used EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev 65 feet m.s.l	Wind: Resultant direction	Resultant speed m.p.h	Average speed m.p.h	Fastest mile: Speed m.p.h	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	53	44	49	-4	46	16	0	1 8	0	.35	0	30.22	11	5.7	7.1	9	S	0.0	0	10	10	1
2	71	52	62	9	56	3	0	1 8	0	T	0	29.95	20	8.7	9.1	19	SW	3.3	33	10	10	2
3	76*	57	67*	14	50	0	2		0	0	0	29.83	30	5.0	10.9	17	N	7.5	71	5	7	3
4	64	53	59	7	44	6	0	8	0	0	0	29.94	36	5.8	7.5	16	N	0.8	8	9	9	4
5	62	44	53	1	37	12	0		0	0	0	30.16	35	7.8	8.3	17	N	9.6	92	3	2	5
6	57	38	48	-4	34	17	0	8	0	0	0	30.40	07	2.1	4.9	10	E	10.4	100	0	0	6
7	63	36	50	-1	42	15	0	8	0	T	0	30.14	18	3.1	5.6	13	S	4.2	41	8	7	7
8	62	54	58	7	47	7	0	1	0	1.07	0	29.56	30	10.4	14.1	29	NW	1.4	14	9	9	8
9	59	44	52	1	38	13	0		0	0	0	29.88	33	18.2	18.4	31	NW	8.1	79	3	3	9
10	57	38	48	-2	36	17	0	8	0	0	0	30.01	32	.8	6.0	10	NW	9.3	91	3	4	10
11	61	45	53	4	45	12	0	1 8	0	.02	0	29.92	34	1.3	5.5	11	NW	0.9	9	9	7	11
12	59	43	51	2	38	14	0	8	0	0	0	30.16	34	3.6	6.3	10	N	8.9	87	3	2	12
13	61	39	50	1	44	15	0	2 8	0	.07	0	30.09	19	4.7	5.5	12	SE	3.3	33	8	7	13
14	60	48	54	6	50	11	0	1 3	0	1.56	0	29.54	03	5.2	7.3	23	NW	0.3	3	10	9	14
15	52	34	43	-5	27	22	0		0	0	0	29.86	33	14.8	14.8	30	NW	4.8	48	7	5	15
16	43	28	36	-12	24	29	0		0	0	0	30.13	36	2.1	6.6	10	NE	7.9	79	9	7	16
17	47	35	41	-6	30	24	0		0	0	0	29.99	34	6.1	7.8	14	NW	0.4	4	10	8	17
18	51	33	42	-5	28	23	0	8	0	0	0	30.15	35	7.0	7.9	13	NW	7.5	75	4	5	18
19	42	40	41	-6	34	24	0	1 8	0	1.42	0	30.12	05	7.5	9.4	17	NW	0.0	0	10	10	19
20	55	35	45	-1	34	20	0		0	.08	0	29.85	33	12.2	12.4	24	NW	5.2	53	6	6	20
21	46	30	38	-8	24	27	0		0	0	0	30.13	34	8.7	9.1	17	NW	5.9	60	5	2	21
22	38	31	35	-11	25	30	0		0	T	T	30.05	35	1.1	5.8	10	NW	0.0	0	10	8	22
23	41	26	34*	-11	21	31	0		0	T	T	30.16	34	4.7	6.9	11	NW	4.2	42	6	3	23
24	50	26	38	-7	21	27	0		0	0	0	30.11	24	7.7	8.1	14	SW	9.8	100	0	0	24
25	47	26*	37	-7	30	28	0	1 8	0	.47	0	29.91	15	2.4	5.3	11	E	2.0	20	10	8	25
26	59	42	51	7	41	14	0	1	0	.35	0	29.26	24	7.8	9.5	19	SW	4.0	41	6	8	26
27	57	39	48	4	30	17	0		0	0	0	29.77	21	12.3	12.5	21	SW	9.7	99	1	3	27
28	60	38	49	6	35	16	0		0	T	0	30.03	24	4.8	9.2	25	NW	3.2	33	8	7	28
29	46	33	40	-3	23	25	0		0	0	0	30.36	34	6.7	7.6	17	NW	9.0	93	5	5	29
30	38	35	37	-5	30	28	0	1 4	0	.66	T	30.02	02	8.8	10.2	18	NE	0.0	0	10	10	30
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	%	Sum	Sum	
	1637	1166				543	2	Number of days		6.05	T	29.99	32	3.2	8.6	31	NW	141.6	for	197	181	
	Avg	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date	09	Possible	month	Avg.	Avg.	
	54.6	38.9	46.8	-0.9	35	24		≥ .01 inch	10	3.21								344.3	41	6.6	6.0	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	829	1186
0	0	6	0	Dep	Dep.
				60	

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	1
Heavy fog X	1
Clear 7	Partly cloudy 8 Cloudy 15

Greatest in 24 hours and dates			
Precipitation		Snow, ice pellets	
1.63	13-14	T	30+

Greatest depth on ground of snow, ice pellets or ice and date	
T	22

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LOCAL CLIMATOLOGICAL DATA

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
DECEMBER 1972

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft Standard time used: EASTERN WBAN #93738

Date	Temperature °F Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65° Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow ice pellets or ice on ground at 07AM In	Precipitation Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev 323 feet m.s.l.	Wind Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Sunshine Hours and tenths	Percent of possible	Sky cover Tenths Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	47	28	38		29	27	0		T	0	0	29.48	24	9.2	10.4	20	27			1	2	1
2	57	30	44		33	21	0		0	0	0	29.75	20	9.7	9.9	15	16			2	2	2
3	64	36	50		37	15	0		0	0	0	29.70	18	5.5	7.9	12	25			0	3	3
4	58	37	48		42	17	0	8	0	T	0	29.73	02	5.6	6.6	9	03			8	9	4
5	64*	32	48		41	17	0	1 8	0	0	0	29.77	35	2.9	5.3	9	36			4	6	5
6	62	35	49		51	16	0	1 8	0	.52	0	29.65	24	1.7	10.4	20	32			10	10	6
7	38	23	31		21	34	0		0	0	0	30.18	34	8.1	8.8	17	32			5	6	7
8	35	22	29		30	36	0	1 6	0	1.24	0	30.09	30	2.9	6.3	10	19			10	10	8
9	52	35	44		43	21	0	1	0	.05	0	29.76	11	.2	5.6	13	19			10	10	9
10	56	44	50		47	15	0	2	0	.15	0	29.66	33	4.3	6.8	17	31			9	9	10
11	44	27	36		27	29	0		0	0	0	30.09	36	7.1	8.2	17	02			9	8	11
12	39	28	34		34	31	0	1 6 8	0	.03	0	30.09	16	4.5	6.9	12	18			10	10	12
13	56	34	45		40	20	0	1	0	T	0	29.81	27	3.7	12.7	20	20			10	10	13
14	41	31	36		32	29	0		0	0	0	30.01	01	3.2	5.0	9	02			10	10	14
15	38	35	37		35	28	0	1	0	.98	0	29.62	35	9.3	9.6	16	35			10	10	15
16	38	19	29		14	36	0		0	0	0	29.55	29	22.2	22.6	32	28			3	3	16
17	28	11*	20*		7	45	0		0	0	0	30.09	30	18.2	19.4	30	30			0	0	17
18	40	12	26		15	39	0		0	0	0	30.03	18	3.7	6.6	13	20			9	7	18
19	55	28	42		21	23	0		0	0	0	29.77	20	8.5	8.6	15	18			10	10	19
20	58	41	50		39	15	0		0	.09	0	29.58	19	3.8	6.9	12	36			8	9	20
21	46	41	44		44	21	0	1 8	0	1.03	0	29.60	05	6.6	7.1	12	04			10	10	21
22	44	38	41		42	24	0	1	0	.89	0	29.36	36	11.7	12.4	20	36			10	10	22
23	45	39	42		43	23	0	1	0	.16	0	29.62	01	9.5	9.9	14	01			10	10	23
24	43	29	36		38	29	0	2	0	T	0	29.75	11	2.3	5.0	8	12			10	9	24
25	45	38	42		42	23	0	2 8	0	T	0	29.74	02	2.0	4.9	7	14			10	10	25
26	43	36	40		40	25	0	2 8	0	.12	0	29.50	20	4.5	8.3	15	31			10	10	26
27	44	27	36		28	29	0		0	0	0	29.48	30	8.2	10.4	17	30			6	7	27
28	47	21	34		28	31	0		0	0	0	29.66	30	7.6	9.8	16	30			6	3	28
29	43	24	34		27	31	0		0	0	0	30.11	21	2.4	7.1	13	14			9	8	29
30	43	34	39		38	26	0	1 8	0	.04	0	30.03	18	2.0	4.6	8	31			10	10	30
31	63	43	53*		52	12	0	2	0	.76	0	29.75	18	4.2	8.5	17	16			10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month						Total	%	Sum	Sum	
	1476	958				788	0	Number of days		6.06	0	29.77	30	2.6	8.8	32	28		for	239	241	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date:	16	Possible	month	Avg.	Avg.	
	47.6	30.9	39.3		34			≥ .01 inch	13											7.7	7.8	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	1931	909
0	1	16	0	Dep.	Dep.

Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	5

Clear 5 Partly cloudy 4 Cloudy 22

Greatest in 24 hours and dates			
Precipitation		Snow, ice pellets	
1.75	21-22	0	

Greatest depth on ground of snow, ice pellets or ice and date	
T	1

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
DECEMBER 1972

Latitude 38° 51′ N Longitude 77° 02′ W Elevation (ground) 10 ft Standard time used: EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev 65 feet m s l	Wind: Resultant direction	Resultant speed m p h	Average speed m p h	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	50	33	42	0	28	23	0		0	0	0	29.76	25	8.9	10.8	28	SW	9.2	95	1	2	1
2	59	36	48	7	32	17	0		0	0	0	30.04	20	7.9	8.1	15	S	9.5	98	2	1	2
3	65	39	52	11	36	13	0		0	0	0	29.99	20	5.7	7.2	12	W	9.6	100	0	2	3
4	61	44	53	13	41	12	0		0	T	0	30.01	04	5.6	5.9	10	NE	5.4	56	6	7	4
5	67*	40	54	14	42	11	0	1 8	0	0	0	30.05	05	4.6	5.3	14	NE	7.3	76	2	6	5
6	65	38	52	13	48	13	0	1 8	0	.32	0	29.92	29	3.6	10.2	29	NW	0.0	0	10	9	6
7	42	32	37	-2	19	28	0		0	0	0	30.47	35	9.0	10.9	20	NW	8.5	89	5	6	7
8	39	34	37	-2	29	28	0	1 8	0	1.35	0	30.37	01	1.4	6.0	13	NW	0.0	0	10	10	8
9	55	39	47	8	43	18	0	1 8	0	.05	0	30.04	12	1.2	5.0	12	S	1.2	13	10	10	9
10	59	48	54	16	47	11	0	1	0	.29	0	29.94	36	3.3	6.3	17	NW	0.0	0	10	9	10
11	48	34	41	3	26	24	0		0	0	0	30.37	34	11.4	11.5	27	NW	5.5	58	9	9	11
12	40	35	38	0	32	27	0	1 8	0	.08	0	30.38	12	3.2	5.8	11	NE	0.0	0	10	10	12
13	61	40	51	13	39	14	0	1	0	T	0	30.09	28	3.1	14.4	20	N	2.7	28	10	10	13
14	44	39	42	4	28	23	0		0	0	0	30.29	04	7.8	8.1	12	N	0.0	0	10	10	14
15	45	38	42	4	35	23	0	1 8	0	.67	0	29.89	01	8.3	11.1	16	NW	0.0	0	10	10	15
16	41	22	32	-6	13	33	0		0	0	0	29.82	29	19.8	20.3	29	W	8.2	86	2	2	16
17	32	20	26*	-12	6	39	0		0	0	0	30.37	31	16.5	16.8	26	NW	9.3	98	0	0	17
18	42	19*	31	-7	15	34	0		0	0	0	30.32	20	5.4	6.6	15	SW	2.6	27	9	7	18
19	57	30	44	6	24	21	0		0	0	0	30.06	20	6.5	6.6	13	S	0.9	9	10	9	19
20	61	43	52	15	38	13	0		0	.06	0	29.86	18	2.6	5.8	10	N	2.9	31	7	9	20
21	48	43	46	9	42	19	0	1	0	.52	0	29.88	05	8.0	8.2	12	NE	0.0	0	10	10	21
22	48	42	45	8	42	20	0	1	0	.81	0	29.62	36	9.4	10.1	17	N	0.0	0	10	10	22
23	48	43	46	9	41	19	0	1	0	.06	0	29.89	03	8.3	8.5	13	N	0.0	0	10	10	23
24	46	39	43	6	38	22	0	1 8	0	T	0	30.04	09	3.3	4.5	13	N	0.0	0	10	8	24
25	48	42	45	8	41	20	0	1 8	0	T	0	30.03	10	2.1	4.3	9	E	0.0	0	10	10	25
26	46	40	43	6	39	22	0	1 8	0	.12	0	29.79	24	4.0	9.8	28	N	0.0	0	10	10	26
27	47	35	41	4	27	24	0		0	0	0	29.76	32	9.1	12.1	20	N	5.0	53	6	6	27
28	51	31	41	4	27	24	0		0	0	0	29.94	30	7.9	9.5	17	NW	4.2	44	5	2	28
29	45	32	39	2	26	26	0		0	0	0	30.41	10	2.8	6.5	12	SE	4.4	46	9	8	29
30	47	38	43	6	37	22	0	1 8	0	.10	0	30.32	06	3.2	4.5	9	E	0.0	0	10	10	30
31	63	45	54*	17	52	11	0	1	0	.12	0	30.03	18	5.8	8.3	23	SE	0.0	0	10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month						Total	% for month	Sum	Sum	
	1570	1133				654	0	Number of days		4.55	0	30.06	33	2.2	8.7	29	W	96.4		233	232	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep						Date.	16+	Possible		Avg	Avg.	
	50.6	36.5	43.6	5.5	33	-180		≥ .01 inch	13	1.77								294.5	33	7.5	7.5	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°	Season to date: Heating Total	Cooling Total
				1483	1186
				Dep.	Dep
0	1	7	0	-120	

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	0
Clear 6	Partly cloudy 5 Cloudy 20

Greatest in 24 hours and dates: Precipitation	Date	Snow, ice pellets	Greatest depth on ground of snow, ice pellets or ice and date
1.40	8- 9	0	0

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
JANUARY 1973

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft. Standard time used: EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog; 2 Heavy fog X; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg station pressure In. Elev 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	63	41	52*		42	13	0		0	0	0	29.72	32	4.6	6.9	14	36			1	4	1
2	45	24	35		23	30	0		0	0	0	29.95	33	9.2	9.8	18	30			6	7	2
3	36	21	29		25	36	0	1 6	0	.22	0	30.11	12	3.7	6.0	12	16			10	8	3
4	48	33	41		37	24	0	2	0	.18	0	29.62	21	1.8	6.6	12	31			9	8	4
5	44	34	39		31	26	0		0	0	0	29.68	31	9.3	10.1	17	32			10	10	5
6	35	21	28		17	37	0		0	0	0	29.83	32	10.9	11.2	18	31			10	7	6
7	24	17	21		6	44	0		0	0	0	30.10	33	[illegible]	11.1	16	32			10	8	7
8	20	17	19*		4	46	0		0	T	T	30.04	01	[illegible]	10.6	15	02			10	10	8
9	30	11	21		7	44	0		0	0	0	29.93	32	7.4	8.5	14	36			0	2	9
10	35	11	23		10	42	0		0	0	0	29.91	24	7.0	7.5	14	27			7	5	10
11	39	8	24		11	41	0		0	0	0	29.70	31	5.3	7.9	15	31			3	2	11
12	33	11	22		7	43	0		0	0	0	29.90	30	7.5	9.1	15	31			0	0	12
13	36	8*	22		12	43	0		0	0	0	30.03	08	.4	5.5	8	15			6	3	13
14	42	11	27		17	38	0		0	0	0	29.79	18	5.1	5.6	12	18			9	8	14
15	42	24	33		30	32	0	6	0	.01	T	29.66	34	5.9	7.2	12	34			10	9	15
16	53	18	36		28	29	0		0	0	0	29.96	21	4.6	8.2	14	20			4	1	16
17	63	21	42		28	23	0		0	0	0	29.90	19	4.0	5.9	9	19			8	6	17
18	64	22	43		32	22	0		0	0	0	29.83	19	2.3	7.1	14	17			10	7	18
19	57	42	50		46	15	0	2	0	.17	0	29.42	21	5.6	10.1	22	30			10	8	19
20	43	26	35		27	30	0		0	0	0	29.52	31	15.4	15.5	26	30			8	5	20
21	46	18	32		17	33	0		0	0	0	29.90	04	3.1	8.1	14	01			7	6	21
22	58	33	46		42	19	0	1	0	.47	0	29.50	19	5.0	9.8	21	14			10	8	22
23	51	40	46		37	19	0		0	T	0	29.42	28	6.6	8.5	13	25			10	8	23
24	43	24	34		23	31	0		0	0	0	29.63	31	10.1	10.8	18	30			3	3	24
25	54	18	36		24	29	0		0	0	0	29.77	21	5.5	7.5	13	24			0	0	25
26	65*	27	46		31	19	0		0	0	0	29.76	21	2.4	6.2	9	17			5	5	26
27	46	38	42		41	23	0	1	0	.45	0	29.54	02	3.7	6.6	14	36			10	10	27
28	47	35	41		42	24	0	2 8	0	.62	0	29.42	16	3.9	6.0	12	14			10	10	28
29	44	21	33		23	32	0	1	0	.13	0	29.38	32	12.9	13.7	28	31			7	6	29
30	34	15	25		12	40	0		0	0	0	29.83	26	4.1	9.1	15	18			8	4	30
31	44	12	28		18	37	0		0	0	0	30.05	14	4.8	4.9	14	12			9	7	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1384	702				964	0	Number of days		2.25	T	29.77	30	3.3	8.4	28	31			220	185	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep						Date:	29	Possible		Avg.	Avg.	
	44.6	22.6	33.6		24			≥ .01 inch	8											7.1	6.0	

Number of days				Season to date			
Maximum Temp.		Minimum Temp.		Total	Total	Snow, ice pellets ≥ 1.0 inch	0
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	2895	0	Thunderstorms	0
0	3	23	0	Dep.	Dep.	Heavy fog X	3

Clear 6 Partly cloudy 7 Cloudy 18

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
.75	28-29	T	15+	0	

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
JANUARY 1973

Latitude 38° 51 N Longitude 77° 02′ W Elevation (ground) 10 ft. Standard time used: EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	64*	46	55*	18	42	10	0		0	T	0	29.99	34	2.5	6.9	14	S	6.6	69	3	5	1
2	48	32	40	3	19	25	0		0	0	0	30.22	34	9.1	9.4	20	N	5.8	61	6	6	2
3	40	29	35	-2	23	30	0	1	0	.18	0	30.41	11	2.8	5.5	10	E	0.8	8	10	8	3
4	49	35	42	5	37	23	0	1	0	.29	0	29.90	25	3.0	7.1	19	NW	1.6	17	9	9	4
5	47	38	43	6	28	22	0		0	0	0	29.96	31	11.1	11.2	22	NW	0.2	2	10	9	5
6	38	25	32	-5	15	33	0		0	0	0	30.10	33	13.6	13.7	23	NW	4.8	50	10	9	6
7	27	19	23	-14	4	42	0		0	0	0	30.38	32	12.7	12.8	23	NW	4.1	43	10	9	7
8	24	20	22*	-15	1	43	0		0	T	T	30.33	02	8.9	9.6	17	N	0.0	0	10	10	8
9	32	18	25	-12	4	40	0		0	0	0	30.22	33	6.9	9.1	16	NW	9.6	100	1	1	9
10	36	17*	27	-10	9	38	0		0	0	0	30.20	24	5.6	6.6	15	NW	8.0	82	7	6	10
11	41	19	30	-7	9	35	0		0	0	0	29.99	30	6.9	8.9	26	NW	9.2	95	1	1	11
12	34	19	27	-10	5	38	0		0	0	0	30.19	33	9.7	10.6	22	NW	9.7	100	0	0	12
13	38	20	29	-8	13	36	0		0	0	0	30.32	33	1.8	4.9	9	SE	6.3	65	5	3	13
14	42	20	31	-6	19	34	0		0	0	0	30.08	18	4.7	5.9	9	S	7.3	75	6	6	14
15	46	31	39	2	29	26	0	8	0	.01	0	29.93	33	3.7	6.2	15	NW	0.0	0	10	9	15
16	53	28	41	4	28	24	0	8	0	0	0	30.24	21	3.6	7.1	14	S	8.8	90	3	1	16
17	59	28	44	7	29	21	0		0	0	0	30.19	19	5.6	5.8	10	S	8.9	91	7	6	17
18	61	31	46	9	34	19	0	8	0	0	0	30.11	20	5.6	5.8	10	S	7.7	79	10	9	18
19	63	41	52	15	45	13	0	8	0	.24	0	29.70	23	7.4	9.9	19	NW	1.0	10	10	9	19
20	46	31	39	2	25	26	0		0	0	0	29.80	32	14.3	14.8	31	NW	0.4	4	9	5	20
21	48	23	36	-1	16	29	0		0	0	0	30.19	35	2.7	6.9	15	NW	8.9	90	6	5	21
22	62	35	49	12	44	16	0	1	0	.38	0	29.78	15	3.6	10.2	21	SW	0.2	2	10	8	22
23	55	43	49	12	35	16	0		0	0	0	29.70	27	6.7	9.6	17	W	0.5	5	9	7	23
24	45	30	38	1	19	27	0		0	0	0	29.91	32	12.9	13.1	28	NW	7.9	79	4	3	24
25	55	26	41	4	23	24	0		0	0	0	30.06	22	4.7	6.8	12	S	10.0	100	0	0	25
26	62	34	48	11	32	17	0	8	0	0	0	30.05	20	4.8	5.6	12	SE	9.0	89	4	4	26
27	48	42	45	8	40	20	0	1	0	.42	0	29.83	36	5.3	7.6	13	88	0.0	0	9	9	27
28	50	43	47	10	42	18	0	1 8	0	.60	0	29.71	12	2.4	4.9	19	44	1.1	11	10	9	28
29	46	24	35	-2	25	30	0	1	0	.14	0	29.64	33	18.3	18.6	34	NW	8.3	81	7	6	29
30	35	20	28	-9	10	37	0		0	0	0	30.12	26	5.3	10.2	22	N	8.6	84	7	3	30
31	46	22	34	-3	19	31	0	8	0	0	0	30.35	13	3.8	6.2	14	SE	8.0	78	8	6	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1440	889				843	0			2.26	T	30.05	31	3.9	8.7	34	NW	163.3		211	181	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep			Dep						Date	29	Possible		Avg	Avg.	
	46.5	28.7	37.6	0.7	23	-28				-0.77								303.9	54	6.8	5.8	

Number of days				Season to date: Total (Heating)	Total (Cooling)
Maximum Temp ≥ 90° ‡	Maximum Temp ≤ 32°	Minimum Temp ≤ 32°	Minimum Temp ≤ 0°	2326	0
0	3	22	0	Dep. -148	Dep.

Number of days	
Precipitation ≥ .01 inch	8
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	0
Heavy fog X	0

Clear 6 Partly cloudy 10 Cloudy 15

Greatest in 24 hours and dates: Precipitation	Date	Snow, ice pellets	Date	Greatest depth on ground of snow, ice pellets or ice and date	Date
.74	28-29	T	8	T	8

A- 180

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
FEBRUARY 1973

Latitude 38° 57′ N Longitude 77 27′ W Elevation (ground) 290 ft Standard time used EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg station pressure In. Elev 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	37	28	33		29	32	0	2 6	0	.02	0	30.13	05	4.6	6.9	12	05			10	10	1
2	64*	32	48*		48	17	0	2 6	0	1.23	0	29.43	15	3.3	8.9	29	30			10	10	2
3	48	34	41		34	24	0		0	0	0	29.33	31	11.0	11.7	25	30			9	8	3
4	53	28	41		29	24	0		0	0	0	29.72	23	6.4	8.8	16	23			3	5	4
5	58	32	45		33	20	0		0	0	0	29.85	01	3.5	5.6	10	07			10	9	5
6	44	35	40		36	25	0	1	0	.58	T	29.92	04	8.7	10.4	17	36			10	10	6
7	50	34	42		36	23	0	1 8	0	T	0	29.88	36	8.4	9.4	15	36			7	8	7
8	44	27	36		36	29	0	1 8	0	.33	0	29.58	25	4.0	10.6	21	32			10	10	8
9	32	20	26		13	39	0		0	0	0	29.82	34	12.4	12.5	20	36			5	4	9
10	27	20	24		13	41	0		0	0	0	29.89	02	15.3	15.5	23	03			10	10	10
11	31	14	23		3	42	0		0	0	0	30.00	36	17.4	17.5	28	36			0	2	11
12	37	7	22		4	43	0		0	0	0	30.05	35	6.5	8.1	13	24			0	0	12
13	45	6	26		10	39	0		0	0	0	30.00	22	3.0	5.0	8	18			1	0	13
14	34	19	27		26	38	0	1 4 6	0	.65	T	29.80	01	2.9	5.8	9	30			10	10	14
15	52	33	43		36	22	0	2 8	0	T	0	29.40	27	2.3	7.1	20	30			9	10	15
16	40	13	27		13	38	0		0	0	0	29.56	31	17.3	17.7	29	30			10	10	16
17	25	5*	15*		-2	50	0		0	0	0	29.95	33	13.0	13.1	21	34			0	0	17
18	35	7	21		4	44	0		0	0	0	30.00	28	1.3	5.9	13	24			9	5	18
19	50	10	30		16	35	0		0	0	0	29.92	21	2.6	4.6	12	20			7	4	19
20	54	23	39		26	26	0		0	T	0	29.80	22	3.3	6.9	16	32			10	8	20
21	50	28	39		29	26	0		0	.02	T	29.69	30	7.2	9.2	23	30			8	8	21
22	40	23	32		16	33	0		0	0	0	29.50	31	16.4	16.5	23	30			3	4	22
23	43	24	34		22	31	0	1	T	.01	.3	29.50	35	5.0	6.8	15	29			6	7	23
24	46	23	35		21	30	0		0	0	0	29.83	30	6.6	10.2	20	31			3	4	24
25	50	17	34		21	31	0		0	0	0	30.07	18	6.3	7.9	14	23			8	6	25
26	51	32	42		30	23	0		0	0	0	29.94	02	6.8	9.5	18	01			10	10	26
27	38	30	34		20	31	0		0	T	T	29.95	02	10.6	11.1	16	36			10	10	27
28	52	18	35		16	30	0		0	0	0	30.03	01	1.2	6.2	9	02			0	1	28
	Sum 1230	Sum 622				Total 886	Total 0			Total 2.84	Total .3	For the month: 29.80	34	4.8	9.6	29	30	Total	% for month	Sum 188	Sum 183	
	Avg. 43.9	Avg. 22.2	Avg. 33.1	Dep.	Avg. 22	Dep.	Dep.			Dep.						Date:	16+	Possible		Avg. 6.7	Avg. 6.5	

Number of days: Precipitation ≥ .01 inch 7; Snow, ice pellets ≥ 1.0 inch 0; Thunderstorms 0; Heavy fog X 3; Clear 8 Partly cloudy 4 Cloudy 16

Season to date: Heating Total	Cooling Total
3781	0
Dep.	Dep.

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
0	4	24	0

Greatest in 24 hours and dates: Precipitation	Date	Snow, ice pellets	Date
1.24	1- 2	.3	23

Greatest depth on ground of snow, ice pellets or ice and date	Date
T	23

LOCAL CLIMATOLOGICAL DATA

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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WASHINGTON, D. C.
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WASHINGTON NATIONAL AIRPORT
FEBRUARY 1973

Latitude 38 51′ N Longitude 77 02′ W Elevation (ground) 10 ft Standard time used EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg station pressure In. Elev 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	41	30	36	-1	30	29	0	2	0	T	0	30.41	05	9.1	9.5	15	E	0.0	0	10	10	1
2	63*	41	52*	15	50	13	0	2	0	1.35	0	29.71	20	4.3	7.9	28	W	0.2	2	10	9	2
3	53	40	47	10	35	18	0		0	0	0	29.60	30	10.1	12.1	25	NW	2.4	23	8	5	3
4	55	37	46	9	28	19	0		0	0	0	29.99	26	6.6	9.5	17	SW	9.9	95	3	4	4
5	58	38	48	11	33	17	0		0	0	0	30.12	08	3.6	7.1	13	NE	4.2	40	10	9	5
6	47	40	44	7	35	21	0	1	0	.46	0	30.19	05	11.1	11.8	23	N	0.0	0	10	10	6
7	53	37	45	8	36	20	0	1	0	.08	0	30.15	35	9.4	9.8	16	N	3.0	29	9	9	7
8	46	33	40	3	37	25	0	1 8	0	.25	0	29.86	25	5.5	10.4	27	NW	0.0	0	10	9	8
9	36	23	30	-7	13	35	0		0	0	0	30.09	34	13.3	13.7	26	NW	8.3	79	6	4	9
10	31	23	27	-10	11	38	0		0	0	0	30.17	03	14.3	14.4	24	NE	0.0	0	10	10	10
11	33	18	26	-11	2	39	0		0	0	0	30.28	36	17.1	17.7	28	N	10.4	98	0	2	11
12	40	13	27	-10	1	38	0		0	0	0	30.33	33	7.1	7.9	16	N	10.7	100	0	0	12
13	45	18	32	-6	14	33	0	8	0	0	0	30.29	18	1.1	3.6	10	NE	10.6	99	1	1	13
14	40	26	33	-5	25	32	0	1	0	.45	0	30.09	08	2.4	4.3	11	E	0.0	0	10	9	14
15	48	36	42	4	36	23	0	2 8	0	.02	0	29.68	24	3.7	5.9	17	NW	2.0	19	10	10	15
16	44	17	31	-7	17	34	0		0	T	T	29.83	32	19.4	19.8	33	N	4.5	42	9	9	16
17	29	9*	19*	-19	- 6	46	0		0	T	T	30.23	33	15.7	16.0	33	N	10.9	100	0	0	17
18	37	13	25	-13	4	40	0		0	0	0	30.30	29	3.1	6.6	11	NW	9.1	83	9	5	18
19	48	20	34	-4	18	31	0		0	0	0	30.21	20	4.7	5.2	9	S	5.0	46	8	4	19
20	54	28	41	2	25	24	0		0	0	0	30.09	23	3.2	6.6	16	NW	3.0	27	10	8	20
21	52	36	44	5	30	21	0	3	0	.07	T	29.97	33	4.9	7.3	17	NW	4.4	40	8	8	21
22	43	27	35	-4	18	30	0		0	0	0	29.77	32	17.1	17.4	29	NW	10.0	91	2	3	22
23	43	28	36	-3	21	29	0		0	T	.1	29.79	33	8.2	8.5	17	NW	4.9	44	6	7	23
24	47	32	40	1	22	25	0		0	0	0	30.11	33	5.5	8.3	21	NW	9.8	88	2	3	24
25	51	27	39	0	24	26	0	8	0	0	0	30.36	18	5.0	6.3	12	SE	7.5	67	8	7	25
26	54	38	46	7	33	19	0	8	0	0	0	30.22	06	5.4	7.9	20	NE	1.7	15	10	10	26
27	41	34	38	-2	23	27	0		0	0	0	30.23	05	12.0	12.4	22	NE	0.0	0	10	10	27
29	51	28	40	0	17	25	0		0	0	0	30.32	09	4.2	6.3	10	NE	11.3	100	0	2	28
	Sum	Sum				Total	Total			Total	Total	For the month						Total	%	Sum	Sum	
	1283	790				777	0	Number of days		2.68	.1	30.08	34	4.5	9.8	33	N	143.8	for	189	177	
	Avg.	Avg	Avg.	Dep.	Avg	Dep.	Dep.	Precipitation		Dep						Date.	17+	Possible	month	Avg.	Avg.	
	45.8	28.2	37.0	-0.8	23	15		≥ .01 inch	7	0.21								301.0	48	6.8	6.3	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°	Season to date: Total	Total
0	2	17	0	3103	0
				Dep	Dep.
				-133	

Snow, ice pellets ≥ 1.0 inch 0
Thunderstorms 1
Heavy fog X 3
Clear 8 Partly cloudy 2 Cloudy 18

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets	
1.35	1- 2	.1	23

Greatest depth on ground of snow, ice pellets or ice and date	
T	23+

A-182

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
MARCH 1973

Latitude 38° 57' N Longitude 77° 27' W Elevation (ground) 290 ft Standard time used EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg station pressure In. Elev 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	60	23	42		27	23	0		0	0	0	30.05	20	9.1	9.8	17	23			8	6	1
2	68	26	47		33	18	0	1 8	0	0	0	30.00	16	5.1	6.8	10	15			8	7	2
3	55	42	49		47	16	0	1 8	0	.29	0	29.94	11	4.0	7.1	14	12			10	10	3
4	55	44	50		49	15	0	2 8	0	T	0	29.82	11	.4	5.6	10	35			10	10	4
5	52	45	49		48	16	0	1 8	0	.26	0	29.91	10	7.4	8.5	14	10			10	10	5
6	45	42	44		43	21	0	1	0	.09	0	30.06	05	8.5	8.6	12	05			10	10	6
7	48	42	45		45	20	0	1	0	.07	0	29.94	07	3.7	6.5	12	08			10	10	7
8	67	44	56		50	9	0	2	0	.15	0	29.85	04	4.4	5.9	10	02			10	9	8
9	67	41	54		44	11	0	2 8	0	0	0	29.96	11	4.5	6.8	15	11			10	9	9
10	61	39	50		42	15	0	1 8	0	T	0	30.01	07	3.9	7.2	13	12			8	8	10
11	56	46	51		49	14	0	1	0	.04	0	29.81	15	5.7	8.1	20	15			10	10	11
12	73*	49	61		49	4	0	1	0	0	0	29.55	26	8.1	14.5	25	31			4	4	12
13	66	43	55		41	10	0		0	0	0	29.75	30	3.3	7.1	13	31			7	7	13
14	72	41	57		45	8	0	1 8	0	0	0	29.62	03	4.0	6.9	12	06			9	8	14
15	72	47	60		50	5	0	1 3 8	0	.03	0	29.53	23	3.9	8.1	17	18			10	10	15
16	68	58	63*		57	2	0	1	0	.19	0	29.42	18	7.2	8.1	15	16			10	10	16
17	72	39	56		45	9	0	1	0	.21	0	28.83	21	19.2	22.6	30	22			8	9	17
18	40	32	36*		23	29	0		0	T	T	29.14	24	17.8	17.8	31	24			10	10	18
19	49	34	42		24	23	0		0	0	0	29.48	28	12.5	15.4	25	25			6	5	19
20	53	29	41		26	24	0		0	0	0	29.57	27	6.0	8.6	18	30			9	9	20
21	42	32	37		29	28	0	1 8	0	.06	.2	29.58	03	9.9	11.1	16	02			10	10	21
22	45	31	38		27	27	0		0	0	0	29.70	34	11.4	11.8	17	35			8	8	22
23	56	30	43		22	22	0		0	0	0	29.86	34	11.2	11.7	22	36			7	5	23
24	64	22*	43		21	22	0		-0	0	0	29.87	30	1.3	5.3	10	35			6	3	24
25	59	30	45		32	20	0	1	0	.26	0	29.56	16	5.6	6.6	16	13			10	8	25
26	57	47	52		47	13	0	1 8	0	.32	0	29.16	35	10.1	10.8	18	02			10	10	26
27	63	36	50		38	15	0	1	0	.07	0	29.52	36	10.9	11.8	20	36			5	5	27
28	59	29	44		28	21	0		0	0	0	29.92	12	6.4	7.6	14	15			3	2	28
29	57	32	45		34	20	0		0	T	0	29.89	16	5.9	6.9	15	16			10	9	29
30	67	48	58		49	7	0	1	0	.21	0	29.80	17	5.3	6.6	12	19			8	9	30
31	55	48	52		51	13	0	2	0	.41	0	29.73	10	6.5	7.2	12	13			10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	1823	1191				500	0	Number of days		2.66	.2	29.70	23	.3	9.3	31	24			264	250	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date:	18	Possible		Avg.	Avg.	
	58.8	38.4	48.6		39			≥ .01 inch	15											8.5	8.1	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
				4281	0
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	Dep.	Dep.
0	0	11	0		

Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	1
Heavy fog X	4

Clear 1 Partly cloudy 6 Cloudy 24

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets	
.52	25-26	.2	21

Greatest depth on ground of snow, ice pellets or ice and date	
T	21

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
MARCH 1973

Latitude 38 ° 51 ' N Longitude 77 ° 02 ' W Elevation (ground) 10 ft Standard time used: EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	59	31*	45	4	27	20	0		0	0	0	30.34	20	9.2	9.4	17	SW	9.2	81	7	6	1
2	66	34	50	9	34	15	0		0	0	0	30.29	18	3.4	4.6	8	S	9.2	81	7	7	2
3	57	47	52	11	47	13	0	1 8	0	.49	0	30.23	07	4.4	6.3	13	E	0.0	0	10	10	3
4	58	47	53	12	48	12	0	1 8	0	T	0	30.09	17	2.2	4.8	8	N	0.0	0	10	10	4
5	54	47	51	10	47	14	0	1 8	0	.24	0	30.19	08	7.5	8.2	16	E	0.0	0	10	10	5
6	47	44	46	4	42	19	0	1	0	.01	0	30.35	05	10.9	11.1	17	E	0.0	0	10	10	6
7	50	44	47	5	44	18	0	1	0	.06	0	30.22	06	6.9	7.2	14	E	0.0	0	10	10	7
8	65	48	57	14	50	8	0	1 8	0	.31	0	30.13	15	2.6	4.3	8	SE	2.5	22	10	9	8
9	67	44	56	13	45	9	0	2 8	0	0	0	30.23	08	5.3	7.2	16	E	9.0	76	8	7	9
10	62	44	53	10	42	12	0	1 8	0	.01	0	30.28	07	6.7	8.1	19	NE	5.1	44	8	8	10
11	55	46	51	8	48	14	0	1	0	.09	0	30.09	13	3.6	7.9	19	S	0.0	0	10	10	11
12	73*	51	62	18	49	3	0	1	0	0	0	29.81	28	7.3	13.8	33	N	10.2	86	4	4	12
13	64	46	55	11	41	10	0		0	0	0	30.02	29	2.6	6.8	13	N	10.2	86	7	7	13
14	71	46	59	15	45	6	0	8	0	0	0	29.89	06	4.4	5.5	17	NE	4.9	41	9	8	14
15	71	48	60	15	49	5	0	3 8	0	.03	0	29.80	14	.7	7.2	21	NE	3.0	25	10	10	15
16	72	61	67*	22	56	0	2	3	0	.15	0	29.69	20	5.2	7.8	17	N	1.0	8	10	10	16
17	72	41	57	12	47	8	0		0	.13	0	29.12	22	20.4	22.9	38	SW	3.8	32	7	8	17
18	44	35	40*	-5	23	25	0		0	T	T	29.41	29	17.0	17.8	32	W	1.0	8	10	10	18
19	52	37	45	-1	23	20	0		0	0	0	29.75	31	14.5	15.7	23	W	7.0	58	4	4	19
20	56	36	46	0	25	19	0		0	0	0	29.86	33	5.2	6.8	14	N	8.6	71	7	8	20
21	46	35	41	-6	32	24	0	1	0	.06	T	29.86	05	12.7	13.5	25	NE	0.0	0	10	10	21
22	47	35	41	-6	26	24	0		0	0	0	29.97	35	14.4	15.1	23	N	4.4	36	9	9	22
23	58	34	46	-1	22	19	0		0	0	0	30.13	36	13.3	13.7	25	N	11.3	92	5	5	23
24	62	33	48	1	23	17	0		0	0	0	30.15	30	1.2	6.3	13	N	12.3	100	2	1	24
25	59	38	49	1	36	16	0	1	0	.44	0	29.86	16	6.5	6.9	12	E	0.3	2	10	9	25
26	61	50	56	8	49	9	0	1 8	0	.26	0	29.43	34	9.1	9.4	21	NW	0.6	5	10	10	26
27	64	45	55	7	40	10	0		0	.02	0	29.78	36	9.9	10.9	20	N	8.0	65	6	5	27
28	58	38	48	-1	30	17	0		0	0	0	30.21	11	6.5	7.6	15	E	12.4	99	4	3	28
29	58	37	48	-1	37	17	0	8	0	T	0	30.18	15	2.9	5.3	10	S	6.9	55	10	8	29
30	63	48	56	6	49	9	0	1 8	0	.22	0	30.09	14	2.8	4.8	10	S	4.0	32	8	7	30
31	57	50	54	4	51	11	0	2 8	0	.45	0	30.03	08	6.4	6.8	10	E	0.0	0	10	10	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	%	Sum	Sum	
	1848	1320				423	2	Number of days		2.97	T	29.98	01	1.4	9.1	38	SW	144.9	for	252	243	
	Avg.	Avg	Avg.	Dep.	Avg	Dep.	Dep.	Precipitation		Dep.						Date	17	Possible	month	Avg.	Avg.	
	59.6	42.6	51.1	6.3	40	-203		≥ .01 inch 16		-0.24								370.8	39	8.1	7.8	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°	Season to date: Heating Total	Cooling Total
				3526	2
				Dep.	Dep.
0	0	1	0	-336	

Snow, ice pellets ≥ 1.0 inch 0
Thunderstorms 2
Heavy fog X 2
Clear 1 Partly cloudy 10 Cloudy 20

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
.70	25-26	T	21+	T	21

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A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
APRIL 1973

Latitude 38 ° 57 ′ N Longitude 77 ° 27 ′ W Elevation (ground) 290 ft Standard time used EASTERN WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence: 1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev. 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	65	53	59		57	6	0	23	0	1.64	0	29.30	16	5.6	7.8	17	30			10	10	1
2	63	49	56		44	9	0	3	0	.09	0	29.22	28	11.5	12.5	21	28			10	10	2
3	64	44	54		41	11	0		0	0	0	29.36	35	3.6	7.8	13	36			7	7	3
4	54	45	50		43	15	0	1	0	.75	0	29.16	33	4.5	10.2	18	30			8	8	4
5	54	42	48		33	17	0		0	0	0	29.39	30	17.2	17.4	24	30			9	7	5
6	68	34	51		32	14	0		0	0	0	29.62	26	8.5	10.5	18	30			0	0	6
7	67	35	51		37	14	0	1	0	.16	0	29.52	13	4.8	6.6	17	07			9	9	7
8	50	35	43		43	22	0	1	0	.53	0	29.36	03	12.3	13.8	23	02			10	9	8
9	60	29	45		36	20	0	2	0	.02	0	29.62	14	7.1	10.2	22	13			3	4	9
10	51	35	43		31	22	0	1	0	.48	T	29.30	27	12.3	12.9	29	27			7	7	10
11	46	31	39		23	26	0		0	T	T	29.58	29	13.8	15.0	23	28			7	7	11
12	42	25	34*		27	31	0	1	0	.13	1.0	29.62	21	4.8	7.1	20	22			9	7	12
13	51	25	38		23	27	0		0	0	0	29.84	32	10.9	11.5	22	31			3	2	13
14	58	24*	41		24	24	0		0	0	0	30.03	02	1.9	5.8	10	36			0	0	14
15	69	29	49		31	16	0		0	0	0	30.10	18	8.7	9.8	15	20			0	0	15
16	73	40	57		33	8	0		0	0	0	30.00	19	14.5	14.8	21	18			8	7	16
17	69	57	63		49	2	0		0	T	0	29.90	19	9.9	10.4	15	19			10	10	17
18	78	57	68		52	0	3		0	.01	0	29.90	20	7.9	8.3	16	22			10	10	18
19	79	56	68		52	0	3		0	0	0	29.87	19	7.2	8.6	16	24			9	9	19
20	79	54	67		53	0	2		0	T	0	29.97	10	7.8	8.3	17	11			8	9	20
21	76	51	64		51	1	0	1 8	0	0	0	30.02	15	7.3	8.3	14	19			6	6	21
22	87*	56	72*		54	0	7		0	0	0	29.68	21	10.4	11.2	17	22			8	8	22
23	82	57	70		56	0	5		0	.32	0	29.48	25	2.3	7.8	22	22			9	9	23
24	76	45	61		49	4	0		0	.02	0	29.52	34	4.1	5.9	10	30			5	6	24
25	60	46	53		47	12	0	1 8	0	1.34	0	29.54	03	8.0	9.6	15	04			10	10	25
26	54	50	52		50	13	0	1 8	0	.20	0	29.46	01	7.3	7.9	14	03			10	10	26
27	52	48	50		48	15	0	1	0	1.65	0	29.11	06	5.1	9.4	21	06			10	10	27
28	56	43	50		39	15	0	1	0	.01	0	29.26	29	12.7	12.9	23	30			10	9	28
29	66	36	51		32	14	0		0	0	0	29.65	29	10.0	10.9	18	28			0	1	29
30	63	40	52		40	13	0		0	T	0	29.83	13	3.6	6.0	9	19			10	9	30
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	%	Sum	Sum	
	1912	1271				371	20	Number of days		7.35	1.0	29.61	26	2.5	10.0	29	27		for	215	210	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep.						Date.	10	Possible	month	Avg.	Avg.	
	63.7	42.4	53.1		41			≥ .01 inch 15												7.2	7.0	

Number of days: Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°	Season to date: Heating Total	Cooling Total
				4652	20
				Dep.	Dep.
0	0	6	0		

Snow, ice pellets ≥ 1.0 inch 1
Thunderstorms 2
Heavy fog X 2
Clear 6 Partly cloudy 5 Cloudy 19

Greatest in 24 hours and dates: Precipitation	Date	Snow, ice pellets	Date	Greatest depth on ground of snow, ice pellets or ice and date	Date
1.73	1- 2	1.0	12	T	12

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
APRIL 1973

Latitude 38° 51′ N Longitude 77° 02′ W Elevation (ground) 10 ft. Standard time used: EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence: 1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg station pressure In. Elev. 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	67	55	61	11	57	4	0	23	0	.50	0	29.58	12	2.2	6.2	20	W	0.7	6	10	10	1
2	65	51	58	7	45	7	0	3	0	T	0	29.48	29	9.7	11.7	23	W	2.2	17	9	8	2
3	65	50	58	7	41	7	0		0	T	0	29.64	35	3.6	7.3	15	N	7.2	57	6	6	3
4	59	49	54	3	44	11	0	1 3	0	.88	0	29.42	01	4.2	8.8	24	NW	3.4	27	9	7	4
5	56	45	51	-1	33	14	0		0	0	0	29.66	30	15.3	15.5	26	W	4.5	35	7	5	5
6	67	41	54	2	32	11	0		0	0	0	29.91	27	7.7	8.6	20	W	12.8	100	0	0	6
7	67	43	55	3	41	10	0	1	0	.20	0	29.81	15	5.1	6.5	17	E	5.9	46	9	7	7
8	51	41	46	-7	43	19	0	1	0	.39	0	29.63	03	12.0	13.7	23	N	0.1	1	10	9	8
9	61	36	49	-4	38	16	0		0	0	0	29.92	14	5.7	7.9	20	S	10.6	82	3	4	9
10	58	39	49	-5	32	16	0		0	.20	T	29.58	28	13.0	15.4	38	W	4.7	36	8	7	10
11	50	37	44	-10	22	21	0		0	0	0	29.86	29	12.8	13.4	27	NW	7.9	60	6	5	11
12	46	33	40*	-14	27	25	0		0	.11	T	29.91	25	5.2	7.6	18	W	3.2	24	9	7	12
13	54	33	44	-11	25	21	0		0	0	0	30.12	32	12.2	12.4	26	N	12.5	95	3	2	13
14	59	32*	46	-9	25	19	0		0	0	0	30.32	35	4.3	6.6	14	N	13.2	100	0	0	14
15	67	35	51	-5	35	14	0		0	0	0	30.40	18	5.9	6.3	13	SE	13.2	100	0	0	15
16	74	42	58	2	37	7	0		0	0	0	30.30	20	10.9	11.1	23	SW	11.9	89	10	7	16
17	72	55	64	8	49	1	0		0	0	0	30.19	19	7.8	7.9	17	S	1.1	8	10	10	17
18	77	58	68	11	53	0	3		0	.02	0	30.18	20	6.6	6.8	13	S	5.9	44	10	10	18
19	79	57	68	10	55	0	3		0	0	0	30.16	18	6.0	6.5	13	SE	9.6	72	8	8	19
20	75	55	65	7	53	0	0		0	T	0	30.26	10	6.6	7.3	18	E	7.3	54	7	8	20
21	75	51	63	5	52	2	0	8	0	0	0	30.31	16	5.1	7.2	13	S	8.0	59	5	5	21
22	86*	60	73*	14	57	0	8		0	0	0	29.97	20	10.0	10.2	17	S	10.5	78	9	8	22
23	83	59	71	12	57	0	6		0	T	0	29.76	22	3.9	7.8	21	N	6.8	50	9	9	23
24	77	54	66	7	49	0	1		0	T	0	29.79	35	2.2	6.9	11	N	13.1	96	4	5	24
25	64	50	57	-3	49	8	0	1	0	.68	0	29.82	06	9.7	10.6	21	NE	0.0	0	10	10	25
26	57	52	55	-5	50	10	0	1 8	0	.44	0	29.73	03	9.2	9.4	15	N	0.0	0	10	10	26
27	56	50	53	-7	50	12	0	1	0	.77	0	29.39	07	6.4	10.9	25	NE	0.0	0	10	10	27
28	60	49	55	-6	39	10	0		0	T	0	29.53	29	12.3	12.7	29	W	3.7	27	10	9	28
29	67	41	54	-7	33	11	0		0	0	0	29.93	29	8.4	9.4	20	NW	13.7	99	0	1	29
30	64	45	55	-7	41	10	0		0	T	0	30.11	11	2.6	4.3	8	E	4.2	30	10	9	30
	Sum	Sum				Total	Total			Total	Total	For the month						Total	%	Sum	Sum	
	1958	1398				286	21	Number of days		4.19	T	29.89	27	2.0	9.2	38	W	197.9	for	211	196	
	Avg.	Avg.	Avg.	Dep.	Avg	Dep.	Dep.	Precipitation		Dep						Date	10	Possible	month	Avg.	Avg.	
	65.3	46.6	56.0	0.3	42	-2		≥ .01 inch	10	1.04								396.7	50	7.0	6.5	

Number of days				Season to date				Greatest in 24 hours and dates				Greatest depth on ground of snow, ice pellets or ice and date	
Maximum Temp		Minimum Temp.		Total	Total	Snow, ice pellets ≥ 1.0 inch	0	Precipitation		Snow, ice pellets			
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	3812	23	Thunderstorms	3	1.08	25-26	T	12+	0	
0	0	1	0	Dep.	Dep.	Heavy fog X	1						
				-338		Clear 6	Partly cloudy 6	Cloudy 18					

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
MAY 1973

Latitude 38° 57′ N Longitude 77° 27′ W Elevation (ground) 290 ft Standard time used EASTERN WBAN #93738

Weather types on dates of occurrence: 1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow

Date (1)	Temperature °F: Maximum (2)	Minimum (3)	Average (4)	Departure from normal (5)	Average dew point (6)	Degree days Base 65°: Heating (7A)	Cooling (7B)	Weather types (8)	Snow, ice pellets or ice on ground at 07AM In (9)	Precipitation: Water equivalent In (10)	Snow, ice pellets In (11)	Avg station pressure In, Elev 323 feet msl (12)	Wind: Resultant direction (13)	Resultant speed m.p.h. (14)	Average speed m.p.h. (15)	Fastest mile: Speed m.p.h. (16)	Direction (17)	Sunshine: Hours and tenths (18)	Percent of possible (19)	Sky cover Tenths: Sunrise to sunset (20)	Midnight to midnight (21)	Date (22)
1	81	42	62		50	3	0		0	0	0	29.85	19	5.2	7.2	16	22			9	8	1
2	84	62	73		53	0	8		0	0	0	29.76	19	13.1	13.5	18	24			8	8	2
3	69	54	62		56	3	0		0	.58	0	29.56	22	6.1	10.4	18	20			10	10	3
4	59	39	49		36	16	0		0	0	0	29.56	30	9.9	10.9	25	31			8	7	4
5	63	38	51		33	14	0		0	0	0	29.61	29	10.5	11.5	22	30			6	4	5
6	71	38	55		37	10	0		0	0	0	29.77	29	6.7	8.8	17	01			6	6	6
7	78	42	60		44	5	0		0	0	0	29.85	15	5.9	8.3	16	20			5	7	7
8	68	55	62		55	3	0	1	0	.52	0	29.71	15	10.2	10.6	17	18			10	10	8
9	79	54	67		58	0	2	1	0	.04	0	29.48	24	6.4	9.6	17	18			7	6	9
10	84*	48	66		52	0	1		0	0	0	29.50	20	8.7	8.9	18	19			6	4	10
11	78	50	64		47	1	0		0	T	0	29.41	27	7.7	11.8	28	30			4	4	11
12	73	44	59		44	6	0		0	T	0	29.50	27	4.7	9.1	16	33			5	3	12
13	70	48	59		44	6	0		0	0	0	29.70	35	4.7	7.2	17	01			5	7	13
14	69	50	60		48	5	0	1	0	T	0	29.83	04	2.5	5.5	13	36			10	9	14
15	67	43	55		45	10	0	1 5	0	.07	0	29.71	34	7.1	8.8	18	31			9	7	15
16	68	36	52		38	13	0		0	0	0	29.62	22	6.3	9.4	16	21			0	0	16
17	63	35	49		44	16	0	1	0	.23	0	29.43	27	4.0	7.6	16	32			8	6	17
18	65	33*	49*		36	16	0		0	.01	0	29.53	27	5.5	8.1	17	30			5	4	18
19	75	40	58		44	7	0		0	0	0	29.53	19	5.0	7.3	14	14			6	7	19
20	66	53	60		54	5	0	1 3 8	0	.37	0	29.35	18	4.5	7.9	17	29			10	10	20
21	72	50	61		47	4	0		0	0	0	29.41	31	11.5	12.8	22	29			3	4	21
22	80	44	62		50	3	0		0	0	0	29.49	27	4.1	7.2	18	28			4	5	22
23	66	56	61		58	4	0	1 8	0	.25	0	29.37	10	1.4	6.6	13	01			10	10	23
24	61	54	58		56	7	0	1	0	.71	0	29.40	09	6.1	7.8	12	08			10	10	24
25	56	52	54		52	11	0	1	0	.01	0	29.49	02	9.0	9.9	13	36			10	10	25
26	57	53	55		53	10	0	1 8	0	.01	0	29.59	13	6.6	7.5	14	14			10	10	26
27	63	54	59		55	6	0	1	0	.11	0	29.56	10	8.7	9.2	14	12			10	10	27
28	83	63	73*		66	0	8	1	0	1.06	0	29.34	18	11.8	14.0	25	20			10	10	28
29	82	61	72		64	0	7		0	T	0	29.45	29	1.0	9.1	16	35			9	9	29
30	82	56	69		58	0	4		0	T	0	29.59	34	4.8	5.9	23	30			6	6	30
31	74	51	63		54	2	0		0	T	0	29.66	27	6.6	8.1	17	28			5	6	31
	Sum 2206	Sum 1498				Total 186	Total 30			Total 3.97	Total 0	For the month: 29.57	24	2.2	9.0	28	30	Total	% for month	Sum 224	Sum 217	
	Avg. 71.2	Avg. 48.3	Avg. 59.8	Dep.	Avg. 49	Dep.	Dep.			Dep.						Date.	11	Possible		Avg. 7.2	Avg. 7.0	

Number of days			
Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
0	0	0	0

Season to date	Heating	Cooling
Total	4838	50
Dep.		

Number of days	
Precipitation ≥ .01 inch	13
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	1
Heavy fog X	0
Clear	2
Partly cloudy	13
Cloudy	16

Greatest in 24 hours and dates: Precipitation	Dates	Snow, ice pellets	Greatest depth on ground of snow, ice pellets or ice and date
1.16	27-28	0	0

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LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
MAY 1973

Latitude 38° 51' N Longitude 77° 02' W Elevation (ground) 10 ft Standard time used: EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In	Precipitation: Water equivalent In	Snow, ice pellets In	Avg station pressure In. Elev. 65 feet m s l	Wind: Resultant direction	Resultant speed m.p.h	Average speed m.p.h	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	78	49	64	2	52	1	0		0	0	0	30.14	17	4.6	6.3	12	S	11.1	80	7	7	1
2	83	60	72	10	56	0	7		0	0	0	30.05	20	11.4	11.7	20	S	7.7	55	9	9	2
3	71	56	64	2	56	1	0	3	0	.41	0	29.85	21	7.0	9.9	19	W	0.8	6	10	10	3
4	61	45	53	-10	36	12	0		0	T	0	29.84	30	10.3	12.5	30	N	6.4	46	7	7	4
5	64	42	53	-10	34	12	0		0	0	0	29.89	30	9.4	11.8	26	NW	10.1	72	6	4	5
6	73	48	61	-2	36	4	0		0	0	0	30.04	32	6.2	9.1	17	NW	12.6	90	6	5	6
7	78	49	64	1	45	1	0		0	0	0	30.14	16	4.9	5.9	18	SE	13.1	94	4	5	7
8	71	59	65	1	56	0	0		0	.38	0	30.01	14	6.1	7.1	16	S	0.4	3	10	10	8
9	78	60	69	5	59	0	4	1	0	.02	0	29.76	21	6.6	8.8	16	S	8.3	59	7	6	9
10	82	54	68	4	57	0	3	8	0	0	0	29.78	19	6.6	6.9	16	S	12.3	87	5	3	10
11	80	59	70	5	48	0	5	3 5	0	.12	0	29.68	28	9.3	12.1	25	W	12.7	89	4	3	11
12	77	52	65	0	45	0	0		0	T	0	29.77	30	4.7	9.5	25	N	11.3	80	4	3	12
13	72	54	63	-2	43	2	0		0	T	0	29.98	34	4.1	6.9	16	NW	11.2	79	4	5	13
14	71	58	65	0	47	0	0		0	.03	0	30.10	06	4.3	5.3	15	NE	4.5	31	9	9	14
15	67	49	58	-7	48	7	0	1 8	0	.08	0	29.98	02	5.6	7.6	19	NW	4.2	29	9	8	15
16	69	41	55	-11	40	10	0		0	0	0	29.91	21	5.4	8.2	16	S	14.3	100	1	0	16
17	73	43	58	-8	46	7	0	8	0	.09	0	29.71	30	4.1	10.9	22	NW	8.2	57	8	5	17
18	65	40*	53*	-14	36	12	0		0	T	0	29.81	28	8.9	10.5	18	SW	10.8	75	4	3	18
19	76	45	61	-6	47	4	0		0	0	0	29.82	16	4.2	5.0	12	S	10.3	72	7	7	19
20	66	58	62	-5	55	3	0	1 8	0	.14	0	29.63	20	4.4	6.9	14	SE	0.3	2	10	9	20
21	73	55	64	-4	47	1	0		0	0	0	29.68	31	11.5	13.4	27	NW	11.0	76	4	4	21
22	81	50	66	-2	49	0	1	8	0	0	0	29.76	26	4.9	7.3	16	NW	11.4	79	3	4	22
23	67	58	63	-5	59	2	0	1 8	0	.43	0	29.65	35	1.6	5.5	16	NE	0.0	0	10	10	23
24	63	55	59	-9	55	6	0	1 8	0	.71	0	29.68	07	8.0	8.9	17	NE	0.1	1	10	10	24
25	57	53	55	-14	52	10	0	1 8	0	.01	0	29.76	04	10.4	10.6	20	NE	0.0	0	10	10	25
26	59	55	57	-12	52	8	0	1	0	T	0	29.88	13	6.6	7.2	12	SE	0.0	0	10	10	26
27	63	55	59	-10	55	6	0	1	0	.19	0	29.86	09	6.7	6.9	13	NE	0.0	0	10	10	27
28	80	62	71	2	66	0	6	1	0	.78	0	29.63	18	8.2	10.4	19	S	3.6	25	10	10	28
29	85*	68	77*	7	65	0	12		0	0	0	29.72	21	4.8	9.6	19	SW	10.5	71	9	8	29
30	82	62	72	2	59	0	7		0	0	0	29.86	31	4.7	8.6	26	NW	11.7	80	6	6	30
31	77	57	67	-3	54	0	2		0	T	0	29.93	31	5.7	7.2	16	W	11.4	78	5	6	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	2242	1651				109	47			3.39	0	29.85	26	1.6	8.7	30	N	230.3		218	206	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.			Dep.						Date:	04	Possible		Avg.	Avg.	
	72.3	53.3	62.8	-3.0	50	35				-0.75								443.2	52	7.0	6.6	

Season to date: Heating Total	Cooling Total
3921	70
Dep.	Dep.
-303	

Number of days

Maximum Temp. ≥ 90° ‡	Maximum Temp. ≤ 32°	Minimum Temp. ≤ 32°	Minimum Temp. ≤ 0°
0	0	0	0

Number of days

Precipitation ≥ .01 inch	13
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	2
Heavy fog X	0
Clear	2
Partly cloudy	15
Cloudy	14

Greatest in 24 hours and dates

Precipitation		Snow, ice pellets	
.95	27-28	0	

Greatest depth on ground of snow, ice pellets or ice and date

0	

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
JUNE 1973

Latitude 38 ° 57 ′ N Longitude 77 ° 27 ′ W Elevation (ground) 290 ft. Standard time used: EASTERN WBAN #93738

Weather types on dates of occurrence: 1 Fog; 2 Heavy fog X; 3 Thunderstorm; 4 Ice pellets; 5 Hail; 6 Glaze; 7 Duststorm; 8 Smoke, Haze; 9 Blowing snow

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Fastest mile: Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	79	48*	64*		51	1	0		0	0	0	29.73	21	4.0	5.8	14	27			2	2	1
2	84	50	67		56	0	2		0	0	0	29.71	16	.9	5.2	9	36			0	0	2
3	83	57	70		62	0	5	1 8	0	T	0	29.76	06	.5	5.2	8	33			10	8	3
4	90	63	77		67	0	12	1 3 8	0	.15	0	29.76	16	3.8	6.9	26	35			6	7	4
5	89	63	76		67	0	11	1 8	0	0	0	29.76	21	4.5	7.8	12	24			2	2	5
6	87	67	77		68	0	12	1 3 8	0	.04	0	29.71	20	7.6	8.2	23	24			8	7	6
7	85	65	75		66	0	10		0	.02	0	29.76	19	4.7	7.8	12	18			5	5	7
8	89	64	77		68	0	12	1 8	0	0	0	29.81	21	4.2	7.6	12	19			5	4	8
9	90	70	80		70	0	15		0	0	0	29.72	20	8.3	9.1	12	22			6	5	9
10	90	67	79		69	0	14	8	0	0	0	29.69	20	3.3	5.3	9	25			2	1	10
11	90	68	79		70	0	14	1 8	0	0	0	29.66	22	5.9	6.8	12	19			4	3	11
12	90	70	80		69	0	15		0	0	0	29.59	21	7.0	8.8	16	20			5	5	12
13	87	69	78		67	0	13	8	0	0	0	29.56	31	5.2	7.3	14	29			9	9	13
14	83	59	71		54	0	6		0	0	0	29.69	33	6.8	8.5	14	32			1	1	14
15	84	52	68		54	0	3		0	0	0	29.70	15	4.3	6.6	13	20			4	4	15
16	85	65	75		67	0	10	1 8	0	.03	0	29.46	22	7.8	8.8	15	23			10	10	16
17	74	64	69		64	0	4	1 8	0	.06	0	29.49	08	4.6	10.4	14	14			10	9	17
18	71	60	66		61	0	1	1 8	0	.08	0	29.64	08	5.3	6.3	10	08			10	10	18
19	77	65	71		64	0	6	1 8	0	T	0	29.76	02	8.2	8.6	12	03			10	10	19
20	87	61	74		66	0	9	2 8	0	0	0	29.80	17	6.2	6.2	14	22			7	7	20
21	90*	70	80*		70	0	15	1 3 8	0	.34	0	29.73	20	6.6	7.3	14	32			9	10	21
22	81	69	75		66	0	10	1 8	0	.32	0	29.71	04	1.6	6.6	15	02			9	9	22
23	84	67	76		67	0	11	1 3 8	0	.06	0	29.68	19	2.7	5.6	9	23			9	9	23
24	86	62	74		66	0	9	1 8	0	T	0	29.65	12	2.5	5.5	12	14			4	4	24
25	87	64	76		66	0	11	1 8	0	0	0	29.65	21	2.7	5.3	14	14			7	5	25
26	84	67	76		66	0	11	1 8	0	0	0	29.68	15	7.4	8.1	13	15			8	7	26
27	84	66	75		68	0	10	1 8	0	.51	0	29.58	16	4.3	6.2	14	14			8	7	27
28	85	68	77		68	0	12	1 3 8	0	.28	0	29.42	17	10.9	11.1	21	18			8	9	28
29	84	66	75		65	0	10	1	0	.02	0	29.40	05	2.1	7.3	12	35			6	7	29
30	85	60	73		60	0	8		0	0	0	29.54	30	2.6	6.0	10	24			2	1	30
	Sum 2544	Sum 1906				Total 1	Total 281			Total 1.91	Total 0	For the month: 29.66	19	2.5	7.2	26	35	Total	% for month	Sum 186	Sum 177	
	Avg. 84.8	Avg. 63.5	Avg. 74.2	Dep.	Avg. 65	Dep.	Dep.			Dep.							Date: 04	Possible		Avg. 6.2	Avg. 5.9	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	4839	331
6	0	0	0	Dep.	Dep.

Number of days
Precipitation ≥ .01 inch 12
Snow, ice pellets ≥ 1.0 inch 0
Thunderstorms 5
Heavy fog X 1
Clear 6 Partly cloudy 11 Cloudy 13

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
.66	21-22	0		0	

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LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
JUNE 1973

Latitude 38° 51' N Longitude 77° 02' W Elevation (ground) 10 ft. Standard time used EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog x, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg. station pressure In. Elev. 65 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	80	55*	68	-2	52	0	3		0	0	0	30.01	24	4.6	7.1	13	SW	13.5	92	2	2	1
2	84	58	71	0	57	0	6	8	0	0	0	29.99	19	2.8	5.2	10	SW	14.1	96	1	0	2
3	86	64	75	4	63	0	10	8	0	0	0	30.04	20	4.0	6.2	10	NW	9.9	67	9	7	3
4	91	67	79	7	68	0	14	1 3 8	0	.12	0	30.04	19	5.5	7.5	30	NW	10.2	69	5	7	4
5	90	67	79	7	67	0	14	8	0	0	0	30.04	19	4.3	6.0	13	S	13.9	94	2	2	5
6	88	72	80	8	69	0	15		0	0	0	29.99	19	10.0	10.2	18	S	12.2	82	8	6	6
7	83	72	78	6	66	0	13		0	T	0	30.04	20	6.9	7.9	13	S	7.7	52	6	5	7
8	91	68	80	8	70	0	15	8	0	0	0	30.09	18	6.6	6.8	13	S	10.9	74	3	3	8
9	93	73	83	10	70	0	18		0	T	0	30.00	21	9.6	9.8	18	SW	13.4	91	7	6	9
10	93	72	83	10	69	0	18	8	0	0	0	29.96	20	3.0	4.6	10	SW	13.2	89	2	1	10
11	93	74	84*	11	72	0	19	8	0	0	0	29.93	20	8.0	8.3	13	SW	11.5	77	1	1	11
12	92	74	83	9	70	0	18		0	0	0	29.87	22	9.6	9.6	17	SW	12.5	84	4	4	12
13	89	74	82	8	67	0	17	8	0	0	0	29.83	30	5.0	9.2	17	NW	11.3	76	7	7	13
14	85	67	76	2	53	0	11		0	0	0	29.95	34	10.6	10.9	17	NW	14.6	98	2	2	14
15	85	61	73	-2	52	0	8		0	0	0	29.97	18	2.2	6.6	15	S	14.6	98	6	4	15
16	86	70	78	3	67	0	13	8	0	.07	0	29.73	21	9.9	10.9	19	SW	5.9	40	9	8	16
17	77	65	71	-4	63	0	6	8	0	T	0	29.77	10	6.2	9.9	20	NE	2.0	13	9	9	17
18	73	62	68*	-7	61	0	3	1	0	.03	0	29.92	07	8.0	8.5	15	NE	1.3	9	10	10	18
19	76	67	72	-3	64	0	7	1 8	0	T	0	30.03	05	8.1	8.9	13	N	0.6	4	10	10	19
20	85	68	77	1	66	0	12	1 8	0	0	0	30.08	16	4.7	5.5	9	S	9.6	64	6	6	20
21	93*	71	82	6	70	0	17	1 3 8	0	1.14	0	30.00	21	4.9	8.2	29	NW	6.2	42	8	8	21
22	82	69	76	0	67	0	11	1 8	0	.32	0	29.98	30	1.7	6.0	22	NW	6.3	42	9	9	22
23	85	70	78	2	67	0	13	1 3 8	0	T	0	29.95	16	3.9	5.5	17	SE	7.5	50	9	9	23
24	83	70	77	0	67	0	12	1 3 8	0	T	0	29.92	13	2.9	5.0	17	NE	8.5	57	5	5	24
25	86	70	78	1	67	0	13	1 8	0	0	0	29.92	15	4.5	5.5	13	E	10.7	72	5	5	25
26	85	70	78	1	67	0	13	1 8	0	0	0	29.96	15	4.9	5.2	13	S	10.4	70	7	7	26
27	85	71	78	1	68	0	13		0	T	0	29.86	13	5.0	6.8	17	S	9.0	60	8	8	27
28	87	70	79	2	68	0	14	3 8	0	.42	0	29.71	18	8.5	8.9	25	W	7.1	48	7	8	28
29	86	69	78	0	67	0	13	3 8	0	.01	0	29.68	20	2.7	5.5	11	W	8.1	54	7	8	29
30	87	67	77	-1	61	0	12	8	0	0	0	29.81	31	3.8	7.1	11	W	13.7	92	2	2	30
	Sum	Sum				Total	Total			Total	Total	For the month.						Total	%	Sum	Sum	
	2579	2047				0	371	Number of days		2.11	0	29.94	19	3.1	7.4	30	NW	290.4	for	176	169	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.	Precipitation		Dep						Date:	04	Possible	month	Avg.	Avg.	
	86.0	68.2	77.1	2.9	65	0		≥ .01 inch	7	-1.10								445.4	65	5.9	5.6	

Number of days				Season to date			
Maximum Temp.		Minimum Temp.		Total	Total	Snow, ice pellets ≥ 1.0 inch	0
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	3921	441	Thunderstorms	6
8	0	0	0	Dep.	Dep.	Heavy fog X	0
				-303		Clear 8 Partly cloudy 12 Cloudy 10	

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets	Greatest depth on ground of snow, ice pellets or ice and date
1.46	21-22	0	0

LOCAL CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

WASHINGTON, D.C.
NATIONAL WEATHER SERVICE OFC
DULLES INTERNATIONAL AIRPORT
JULY 1973

Latitude 38 ° 57 ' N   Longitude 77 ° 27 ' W   Elevation (ground) 290 ft   Standard time used EASTERN   WBAN #93738

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In.	Snow, ice pellets In.	Avg station pressure In. Elev 323 feet m.s.l.	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	85	63	74		66	0	9	1 3 8	0	.59	0	29.68	18	3.6	6.6	13	19			8	8	1
2	83	68	76		69	0	11	2 8	0	.13	0	29.75	12	3.0	6.2	10	09			10	9	2
3	90	69	80		72	0	15	1 3 5 8	0	.52	0	29.68	20	6.5	6.8	17	16			9	7	3
4	90	68	79		69	0	14	1 8	0	T	0	29.53	25	3.5	6.8	10	28			6	6	4
5	88	68	78		67	0	13		0	0	0	29.46	33	6.1	6.5	14	30			7	7	5
6	85	62	74		59	0	9		0	0	0	29.65	33	2.8	5.2	14	30			6	5	6
7	89	61	75		64	0	10	1 8	0	0	0	29.73	18	4.1	4.6	9	26			1	1	7
8	92	64	78		69	0	13	1 8	0	0	0	29.72	24	2.6	6.6	12	30			1	1	8
9	93	69	81		72	0	16	1 8	0	0	0	29.64	28	1.6	5.5	12	27			5	4	9
10	92	69	81		70	0	16	1 3 8	0	.34	0	29.50	26	1.8	4.5	16	12			10	9	10
11	86	64	75		64	0	10	1 8	0	T	0	29.45	31	6.1	8.6	16	36			7	6	11
12	78	52*	65*		51	0	0		0	0	0	29.64	33	5.7	7.9	17	36			4	2	12
13	90	56	73		61	0	8		0	0	0	29.62	20	9.9	10.2	17	20			3	4	13
14	93*	67	80		69	0	15	1 8	0	0	0	29.54	20	4.5	6.9	12	21			3	3	14
15	85	70	78		70	0	13	1 3 8	0	.10	0	29.52	33	2.0	7.5	14	01			9	9	15
16	86	66	76		65	0	11	1 8	0	T	0	29.65	03	5.9	7.8	13	06			4	5	16
17	82	65	74		65	0	9	1 8	0	.07	0	29.79	19	2.2	6.5	9	18			9	8	17
18	87	61	74		64	0	9	2 8	0	0	0	29.84	20	4.1	5.2	12	17			3	2	18
19	90	62	76		64	0	11		0	0	0	29.79	18	8.3	8.5	15	18			1	2	19
20	91	69	80		69	0	15	1 3 8	0	1.42	0	29.66	19	4.9	6.6	17	27			8	8	20
21	83	70	77		71	0	12	1 3 8	0	1.15	0	29.54	19	2.5	8.2	21	29			10	9	21
22	74	68	71		68	0	6	1 8	0	.22	0	29.72	03	5.8	6.9	10	01			10	10	22
23	85	65	75		67	0	10	1 8	0	.05	0	29.92	10	2.4	5.9	12	14			7	6	23
24	85	60	73		63	0	8	2 8	0	0	0	29.94	21	3.2	5.6	9	18			7	6	24
25	79	61	70		64	0	5		0	0	0	29.78	18	8.4	8.8	14	22			10	8	25
26	88	69	79		70	0	14		0	.35	0	29.60	19	9.5	9.6	14	18			7	8	26
27	91	72	82*		70	0	17	8	0	T	0	29.54	20	6.4	7.6	14	20			5	6	27
28	89	67	78		68	0	13	1 8	0	T	0	29.58	18	5.3	6.2	9	18			7	5	28
29	85	65	75		65	0	10		0	0	0	29.60	31	4.8	6.6	14	30			3	3	29
30	88	61	75		62	0	10	1 8	0	0	0	29.70	22	.7	4.6	12	09			3	2	30
31	89	65	77		68	0	12	1 3 8	0	.05	0	29.67	16	3.9	5.6	10	13			5	5	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	% for month	Sum	Sum	
	2691	2016				0	344			4.99	0	29.66	21	2.1	6.8	21	29			188	174	
	Avg.	Avg.	Avg.	Dep.	Avg.	Dep.	Dep.			Dep.						Date:	21	Possible		Avg.	Avg.	
	86.8	65.0	75.9		66	0														6.1	5.6	

Number of days				Season to date	
Maximum Temp.		Minimum Temp.		Total	Total
				0	675
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	Dep.	Dep.
10	0	0	0	0	

Number of days	
Precipitation ≥ .01 inch	12
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	7
Heavy fog X	3

Clear 8   Partly cloudy 13   Cloudy 10

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets	
1.43	20-21	0	

Greatest depth on ground of snow, ice pellets or ice and date	
0	

LOCAL CLIMATOLOGICAL DATA

A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

WASHINGTON, D. C.
NATIONAL WEATHER SERVICE OFC
WASHINGTON NATIONAL AIRPORT
JULY 1973

Latitude 38 ° 51 ' N Longitude 77 ° 02 ' W Elevation (ground) 10 ft Standard time used EASTERN WBAN #13743

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days Base 65°: Heating	Cooling	Weather types on dates of occurrence (1 Fog, 2 Heavy fog X, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM In.	Precipitation: Water equivalent In	Snow, ice pellets In	Avg. station pressure In. Elev. 65 feet m s l	Wind: Resultant direction	Resultant speed m.p.h.	Average speed m p h	Fastest mile: Speed m p h	Direction	Sunshine: Hours and tenths	Percent of possible	Sky cover Tenths: Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	86	69	78	0	67	0	13	8	0	T	0	29.96	18	5.4	6.5	16	S	10.9	73	8	8	1
2	86	72	79	1	71	0	14	1 8	0	.59	0	30.02	11	2.9	5.9	15	S	6.1	41	9	9	2
3	89	73	81	3	72	0	16	1 3 8	0	.07	0	29.96	18	6.4	6.8	13	N	9.5	64	8	8	3
4	92	71	82	4	70	0	17	1 8	0	0	0	29.80	23	4.7	6.5	12	W	12.8	86	4	5	4
5	88	74	81	3	65	0	16		0	0	0	29.73	33	7.5	8.1	15	NW	11.4	77	6	6	5
6	86	68	77	-1	58	0	12		0	0	0	29.92	35	6.2	8.2	13	N	14.7	99	6	5	6
7	89	67	78	0	63	0	13	8	0	0	0	30.00	20	4.8	5.3	12	S	14.4	97	1	1	7
8	93	70	82	4	68	0	17	8	0	0	0	29.99	18	4.3	5.0	9	S	13.3	90	3	2	8
9	95	75	85	7	71	0	20	8	0	0	0	29.90	28	3.6	6.9	15	NW	13.5	92	4	4	9
10	94	72	83	5	70	0	18	3 8	0	.48	0	29.76	28	3.5	5.8	24	W	9.3	63	7	7	10
11	86	70	78	0	64	0	13	8	0	T	0	29.71	32	6.7	8.6	22	NW	9.7	66	7	7	11
12	80	61*	71*	-7	48	0	6		0	0	0	29.91	32	10.9	12.4	21	NW	14.7	100	2	1	12
13	91	63	77	-1	60	0	12		0	0	0	29.90	21	10.8	10.9	17	W	12.2	83	4	3	13
14	95*	72	84	6	69	0	19	8	0	0	0	29.82	21	8.1	8.5	15	S	12.9	88	2	3	14
15	84	71	78	0	69	0	13	8	0	.15	0	29.79	27	2.0	9.2	17	W	7.2	49	9	10	15
16	87	68	78	0	63	0	13		0	0	0	29.92	06	7.5	8.9	14	N	9.7	66	5	7	16
17	83	71	77	-1	63	0	12	8	0	T	0	30.06	11	2.6	6.5	11	NE	7.6	52	9	7	17
18	87	67	77	-2	64	0	12	1 8	0	0	0	30.12	20	5.1	5.8	12	S	12.6	86	2	1	18
19	90	67	79	0	64	0	14	8	0	0	0	30.07	19	7.9	8.2	15	S	13.3	92	0	1	19
20	90	75	83	4	69	0	18	3 8	0	.15	0	29.94	19	7.7	8.8	16	SW	9.2	63	7	8	20
21	87	73	80	1	72	0	15	1 3 8	0	.62	0	29.82	23	3.9	8.8	13	N	6.3	44	8	9.	21
22	78	69	74	-5	66	0	9	1 8	0	.25	0	29.99	05	7.2	8.2	11	N	0.7	5	10	10	22
23	87	73	80	1	65	0	15	8	0	T	0	30.19	08	4.3	6.6	12	E	10.8	75	5	6	23
24	87	67	77	-2	60	0	12	8	0	0	0	30.22	15	2.7	5.6	9	SE	12.8	89	4	4	24
25	85	66	76	-3	63	0	11		0	0	0	30.07	19	7.1	7.8	14	S	8.5	59	9	8	25
26	89	71	80	1	68	0	15		0	.07	0	29.89	20	14.1	14.2	17	S	10.5	73	4	6	26
27	93	76	85*	6	70	0	20		0	0	0	29.81	22	9.7	10.1	16	SW	9.2	64	6	6	27
28	92	73	83	4	71	0	18	8	0	0	0	29.85	19	6.7	7.1	14	S	9.4	66	8	7	28
29	88	72	80	1	65	0	15		0	0	0	29.88	31	6.1	9.1	15	S	10.8	76	3	3	29
30	89	68	79	0	61	0	14		0	0	0	29.97	05	2.5	6.0	9	E	10.7	75	3	2	30
31	91	70	81	3	67	0	16	8	0	.30	0	29.95	18	4.2	5.2	14	SE	7.7	54	3	5	31
	Sum	Sum				Total	Total			Total	Total	For the month:						Total	%	Sum	Sum	
	2737	2174				0	448	Number of days		2.68	0	29.93	21	2.5	7.8	24	W	322.4	for	166	169	
	Avg.	Avg.	Avg.	Dep.	Avg	Dep.	Dep.	Precipitation		Dep.						Date:	10	Possible	month	Avg.	Avg.	
	88.3	70.1	79.2	1.0	66	0		≥ .01 inch	9	-1.47								452.0	71	5.4	5.5	

Number of days				Season to date: Heating Total	Cooling Total
Maximum Temp		Minimum Temp		0	889
≥ 90° ‡	≤ 32°	≤ 32°	≤ 0°	Dep	Dep
11	0	0	0	0	

Number of days	
Snow, ice pellets ≥ 1.0 inch	0
Thunderstorms	4
Heavy fog X	0
Clear 9	Partly cloudy 13 Cloudy 9

Greatest in 24 hours and dates: Precipitation		Snow, ice pellets		Greatest depth on ground of snow, ice pellets or ice and date	
.87	21-22	0		0	

APPENDIX H

LITERATURE REVIEW ON URBAN RUNOFF - 10 OCTOBER 1972

INTRODUCTION

Although it is now of common concern that the air, the land and the water are all subject to contamination as industry and populations continue to grow or concentrate, the complex relationships among these interlocking ecological spheres are largely unexplored. Water pollution arising from stormwater runoff in urban areas, nonetheless, is a resultant product of these complex relationships. Either the lack of understanding of these relationships or changes in them now make questionable one of the most generally accepted "modern" maxims in sanitary engineering: that urban areas should be served with separate sewerage systems with the storm sewers discharging untreated runoff directly to receiving waters. That this basis may not be valid is implied by an increasing number of statements such as "Until recently, it was assumed that stormwater discharged from separate sewer systems was relatively unpolluted. Indeed this assumption is one of the important justifications for separate systems"(1). The purpose of this literature review is to provide an overview of the relationships of urban stormwater runoff to the total water pollution problem. The view will also delve into analytical aspects of urban runoff pollution and provide information and interpretations of data.

The total pollutional load borne by a receiving body of water serving an urban area results from a combination of factors including effluents from sewage treatment plants, urban stormwater runoff, overflow from combined sewerage systems, industrial and other wastes discharged directly with and without prior treatment, plus that portion of the upstream load not yet assimilated. A detailed analysis of all aspects of the problem is required in order to develop efficient systems for meeting existing or future stream water quality standards at minimum cost. The analysis might conclude that a number of acceptable tradeoffs or treatment schemes with respect to urban stormwater runoff exist in a particular drainage area. As previously stated, the contribution of urban stormwater runoff has only recently been recognized and much additional information concerning this source of water pollution must be gathered to bring the "body of related knowledge" up to a par with that already acquired for the other sources of water pollution.

The following questions on urban stormwater runoff need to be answered:

1. To what extent does the pollution load from urban runoff affect the water quality of the receiving waters?

2. How does the pollutional load from urban runoff compare with the total water pollution in a given drainage area: (a) on a yearly basis, and (b) on a shock load basis as occurs during a storm event?

3. What are the concentrations of pollutants in urban stormwater runoff and how do these concentrations vary during the course of a rainstorm? How do these concentrations compare with raw sewage and sewage treatment plant effluents, and is it necessary to treat any or all of the runoff from a particular storm event.

4. What factors contribute to runoff pollution in urban areas? Is the contribution from roadways significant? What is known about the effects of motor vehicle traffic upon urban runoff?

5. What are the significant gaps in the knowledge presently available concerning the aforementioned areas and what types of studies will be required to understand and treat the problems arising from urban runoff pollution?

In the review of the literature to follow, it will be seen that a great deal of information exists on the subject of urban runoff. However, this information has yet to form a coherent whole which can provide a clear picture of the full extent or complete nature of the problem.

URBAN RUNOFF - A FACTOR IN WATER POLLUTION

In June 1969, <u>Environmental Science and Technology</u> summarized in its "Outlook" column the results of a survey undertaken by the American Public Works Association (APWA):

> In general, APWA finds that urban runoff amounts to 1% of the raw sewage for the particular area. Another way of looking at the magnitude of the pollution potential is that this water pollution potential amounts to 5% of the BOD discharged from the area's secondary waste treatment facilities. But the water pollution from this urban source occurs only during rainfall or snow thaw. Assuming that a 14-day accumulation of street litter and that all of the soluble BOD in the dust and dirt fraction would be discharged into the street inlets during a two-hour storm, APWA estimated that the shock pollution load on the receiving waters would be 160% of the raw sewage BOD and 800% of the secondary treatment effluent during the two-hour period (2).

While the APWA study, conducted in the Chicago area, shows urban runoff to be significant only in terms of shock loading of receiving waters, studies in other urban areas have shown an even more dramatic contribution from this source. For example, storm drainage from urban areas in Atlanta, Georgia constitutes 65% of the annual pollution load, in terms of BOD, contributed by the metropolitan area to the South River. This study found that a storm of two-week frequency caused anaerobic conditions to exist 19 miles below the study area (3). In a similar study (4) conducted at Cincinnati, Ohio, urban runoff again proved to be a significant source of water pollution both in terms of annual load and on the basis of daily discharges during storms. This study was conducted on a 27 acre residential and light commercial urban area of Cincinnati having a population density of nine persons per acre. Constituent loads in urban runoff from the area, calculated on an annual basis as percentage of sanitary sewage production at a nine-person per acre population density were as follows:

Suspended Solids	160%
COD	33%
BOD	7%
Total Phosphate	5%
Total Nitrogen	14%

During runoff, the corresponding stormwater runoff rates were:

Suspended Solids	2,400%
COD	520%
BOD	110%
Total Phosphate	70%
Total Nitrogen	200%

Assuming a sewage treatment plant of about 80%, these results should be multiplied by a factor of five to estimate the contributions to the receiving waters of stormwater runoff relative to those of sewage treatment plant effluent. Results of an urban runoff study conducted in Tulsa, Oklahoma are shown in Table 1 (5). Again, a significant contribution of urban runoff to the total water pollution load is demonstrated.

TABLE 1. ESTIMATED DAILY LOAD OF POLLUTANTS ENTERING THE TULSA, OKLAHOMA AREA RECEIVING STREAMS[a]

	Average Daily Pollution Load (lbs.)			Relative
Parameter	Stormwater[b]	Sewage Treatment Plant Effluents	Total	Contribution of Stormwater (%)
BOD	4,455	19,370	23,825	20
COD	30,803	67,180	97,983	31
Susp. Solids	107,200	18,400	125,600	85
Org. Kjeld. N.	355	760	1,115	31
Sol. PO_4-P	469	11,020	11,489	4

(a) These results are taken from Reference 5, page 115.

(b) The reported values for stormwater were calculated from the total load on a yearly basis averaged over each day of the year.

The above-mentioned studies, and others (6, 7, 8, 9, 10), amply demonstrate that urban runoff is a significant source of pollution, both in terms of shock load and fraction of the total water pollution entering a body of water serving an urban drainage area. These findings make it apparent that stormwater runoff must be reduced or treated prior to discharge if water quality of the receiving waters is to be protected. In order to devise cost effective systems for handling this problem, information is required concerning the quality and quantity of urban runoff. Also, information on the temporal distributions of these parameters in relation to rainfall intensity during runoff periods should be known. Means and ranges of concentrations of solids, organic materials, nutrients and microorganisms in urban runoff are presented in Table 2, 3 and 4. These are comparative data for qualitative review in that intensities, duration and frequencies of storms and characteristics of drainage areas and sewerage systems have not been adjusted to a common basis for comparison. The concentration data, coupled with estimates of volume, support the conclusion that runoff from urban areas constitutes a serious source of water pollution.

Examination of ranges in Tables 2 and 3 reveals that, for some portion of the storm event, runoff is relatively free of pollutants. This has led to a number of investigations in which pollutant concentrations, runoff volume and rainfall intensity were measured as a function of time in the hopes that these studies would demonstrate that at least some of the runoff need not be treated. Figure 1 (11) shows this diagramatically. Unfortunately, these studies have led to widely varying results indicating that runoff elements of the particular drainage system must be studied individually to determine which, if any, portions of the runoff may be discharged without treatment. To quote a 1949 Detroit Michigan study conducted by C. L. Palmer (12), "In some cases the quality of the material became worse as the storm progressed and in others it became better, and in still others no pattern was apparent." However, review of a number of these studies (3, 4, 5, 7, 8, 9, 13, 14) has led to the following general conclusions:

1. Concentrations of pollutants in urban runoff tend to diminish after the initial flushing for rainfalls of extended duration.

2. The quantities of pollutants discharged during the initial flush of storm runoff is directly related to the length of antecedent dry-weather period.

3. Peak loadings usually occur close to the point of maximum flow.

4. Urban stormwater runoff is generally high in COD and suspended solids.

Despite the lack of uniformity in performance by individual urban storm sewer systems, a number of mathematical models have been developed (5, 7, 21) which, given the necessary data inputs, enable computerized predic-

TABLE 2. QUALITY OF URBAN STORMWATER RUNOFF

	Ref. 15 Cincinnati, Ohio		Ref. 9 Minsk and Soligorsk, USSR		Ref. 16 Chicago, Illinois		Ref. 17 Washington, D. C.		Ref. 18 Sacramento, California		Ref. 13 Lawerence, Kansas		Ref. 19 Tulsa, Oklahoma	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
BOD (mg/l)	17	1/173	----	12.5/145	----	70/175	19	3/90	----	24/283	6.9	4.6/12.3	12	1/39
COD (mg/l)	111	20/610	----	52/1720	----	-------	335	29/1514	----	27/176	33	11/69	85	12/405
SS (mg/l)	227	5/1200	----	450/5000	----	100/290	1697	130/11,280	----	19/208	411	78/924	----	--------
TS (mg/l)	-------	-----------	----	--------	----	-------	2166	338/14,600	----	------	536	344/4920	----	--------
TVS (mg/l)	-------	-----------	----	--------	----	-------	302	10/1004	----	------	149	22/733	----	--------
PO_4-P (mg/l)	-------	-----------	----	--------	----	-------	----	----------	----	------	---	--------	----	--------
Tot. PO_4-P (mg/l)	0.3	0/1.8	----	--------	----	-------	0.3	0.1/1.1	----	------	---	--------	----	--------
NO_2-N (mg-l)	-------	-----------	----	--------	----	-------	-------	----------	----	------	---	--------	----	--------
NO_3-N (mg/l)	1.0 [a]	0.1/3.4 [a]	----	--------	----	-------	2.1 [b]	0.5/6.5 [b]	----	------	1.7	0.6/4.0	----	--------
NH_3-N (mg/l)	-------	-----------	----	--------	----	-------	-------	----------	----	------	---	--------	----	--------
Org.-N (mg/l)	3.1 [b]	0.3/7.5 [b]	----	--------	----	-------	-------	----------	----	------	---	--------	----	--------
Coliforms (/100 ml) (x 10^{-3})	-------	2.9/460	----	25/250	----	-------	600	120/3200	----	------	---	--------	----	2.1/1140
Fec. Col. (/100 ml) (x 10^{-3})	-------	0.5/76	----	--------	----	-------	310	40/1300	----	6/600	---	--------	----	0.002/30
Fec. Strep. (/100 ml) (x 10^{-3})	-------	4.9/110	----	--------	----	-------	21	3/60	----	------	---	--------	----	5/167

(a) Total inorganic nitrogen, sum of NO_2-N, NO_3-N and NH_3-N.
(b) Total nitrogen, inorganic plus organic.

TABLE 3. CHEMICAL CHARACTERISTICS OF URBAN STORMWATER RUNOFF (2)

Location and Date	Parameter (mg/l)								
	BOD		COD		Organic N		Soluble PO4		SS
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Mean
Cincinnati 7/62-9/63	2-84	19	20-610	99	0.2-4.8	1.7	0.07-4.3	0.8	210
Detroit 1949	96-234	147	----------	---	--------	---	--------	---	-----
Ann Arbor 1965	Max. 62	28	----------	---	Max. 4.0	1.0	Max. 3.4	0.8	2,080
Oxney, Eng. 1954	Max. 100	---	----------	---	--------	---	--------	---	-----
Moscow, USSR 1948-1950	186-285	---	----------	----	--------	---	--------	---	-----
Leningrad, USSR 1948-1950	--------	36	----------	---	--------	---	--------	---	-----
Seattle 1959-1960	--------	10	----------	---	Max. 9.0	---	--------	---	-----
Stockholm 1945-1948	Max. 80	17	Max. 3,100	188	--------	---	--------	---	-----
Pretoria, S. Africa									
Residential	--------	30	----------	29	--------	5.4	--------	---	-----
Business	--------	34	----------	28	--------	3.5	--------	---	-----

TABLE 4. BACTERIAL CHARACTERISTICS OF URBAN STORMWATER RUNOFF (20)

Location and Date	Source	Bacteria (Number/100 ml) Total Coliform	Fecal Coliform	Fecal Streptococcus	Remarks
Cincinnati 7/62-4/63		58,000	10,900	20,500	(Median Values)
Cincinnati 1/62-1/64	Street Gutters				
	Spring	1,400	230	3,100	(Median Values)
	Summer	90,000	6,400	150,000	
	Autumn	290,000	47,000	140,000	
	Winter	1,500	50	2,200	
	Business District				
	Spring	22,000	2,500	13,000	(Median Values)
	Summer	172,000	13,000	51,000	
	Autumn	290,000	40,000	56,000	
	Sinter	46,000	4,300	28,000	
Seattle 1959-1960		15,000			MPN/100 ml
Pretoria S. Africa	Residential	240,000			
	Business	230,000			MPN/100 ml

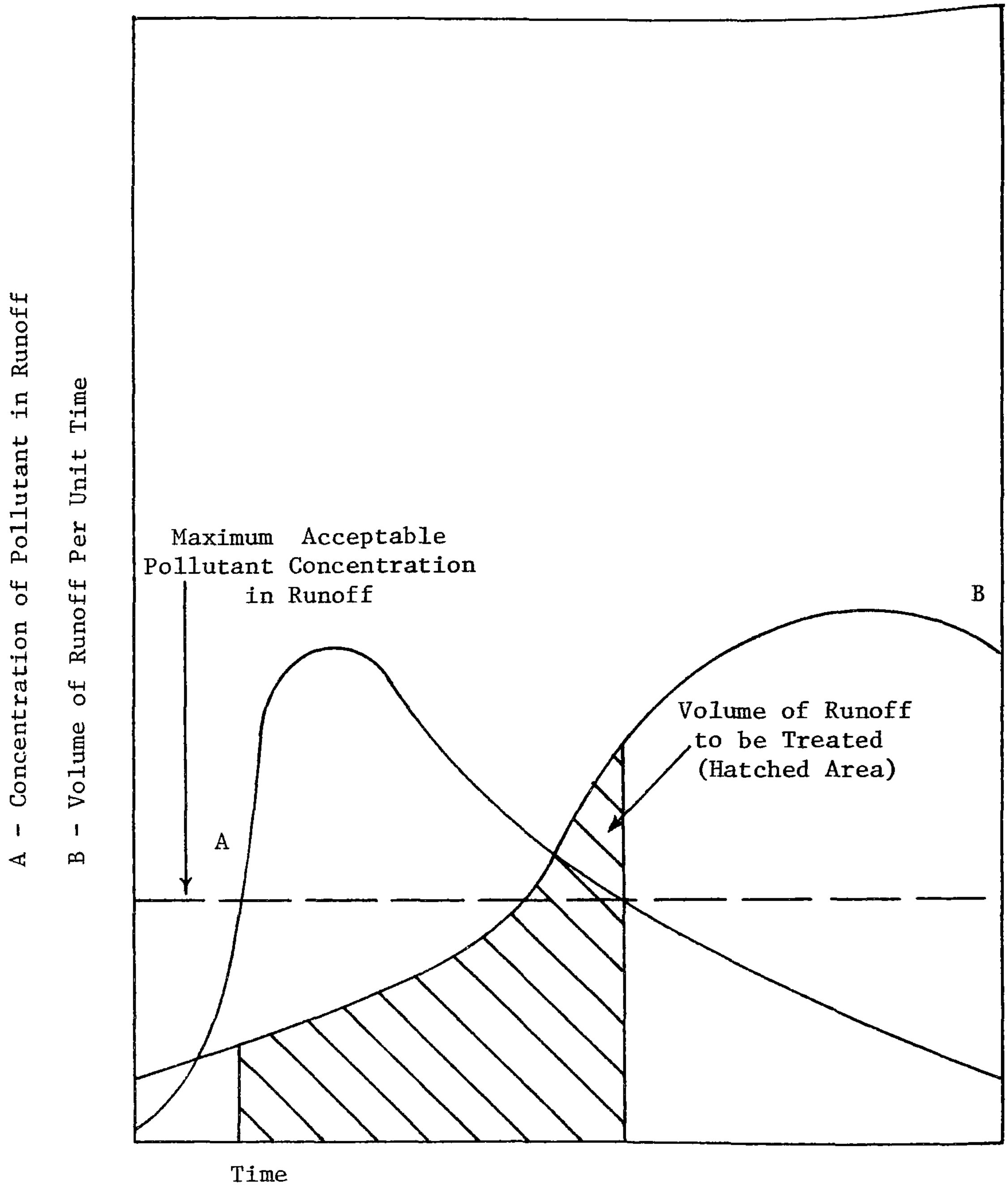


Figure 1. Diagrammatic quality and quantity hydrographs for stormwater runoff (11)

tions of the quantity and quality of urban storm runoff and combined sewer overflow. These predictive models represent an important initial step towards successful handling of the urban stormwater runoff problem.

URBAN RUNOFF - THE CONTRIBUTION OF STREETS AND ROADWAYS

Qualitative statements referring to the contributions of urban roadway and motor vehicular traffic runoff pollution appear throughout the literature cited in the previous section. It is not surprising that roadways have a significant effect upon urban runoff since they constitute a high percentage of the total area in cities and impervious roadway surfaces have high runoff coefficients. There have been two in-depth studies relating to the contributions of runoff from streets and roadways to water pollution. The first, conducted by APWA, surveyed all factors contributing to urban runoff and concluded that:

> The most determinable measure of pollution potential of street litter was deemed to be the BOD of the soluble dust and dirt fraction. This BOD varied from three to 14 mg/g of dry material. As stated, the average was 5 mg/g. This amounted to 0.40 pounds of BOD per day per curb mile. Compared to the BOD reduction of 80% considered attainable for secondary treatment of sewage, the BOD of the street litter was equivalent to 25 persons per day per mile. National population densities per mile of roadways and streets indicate that for a city of Chicago's size, 500 persons would live adjacent to each mile of street. Thus, with a street litter BOD equivalency of five persons per day per mile, street litter would have a pollution potential of 1% of the raw sewage pollution loading and 5% of the secondary treatment effluent described above (22).

The second significant study (23) was conducted by URS Research Company into the water pollution effects of street surface contaminants. The investigators stated that, "It is with reasonable assurance that we conclude that street surface contaminants represent a significant non-point source of pollution of receiving waters" (24). These two studies produced the first quantitative information on the surface loadings of pollutant per unit area or length of roadway. Variations in loadings with land use, zoning, traffic intensity and other factors are discussed. Data reported by APWA (25) for gutter sweeping studies in Chicago in 1967 are shown in Table 5. Statistical analyses of these data reveal strong indications that the amounts of BOD and COD in dust and dirt samples, unaffected by rainfall, are directly proportional to traffic intensity, regardless of zoning, land use, street width and other factors; see Table 6 and Figure 2 (26). The dust and dirt was found by these analyses to contain a loading of 0.14 pounds of BOD and 0.80 pounds of COD per 1,000 feet of curb per 10,000 vehicles.

Thus far in the literature review, we have discussed stormwater runoff more or less in conventional terms as regards wastewater and compared it to sanitary sewage or sewage treatment plant effluents. However, the

TABLE 5. VARIATION OF DUST AND DIRT LOADING RATES WITH TRAFFIC INTENSITY [a] (25)

Area	Zoning	Traffic (Vehicles/day x 10^{-4})	Dust and Dirt Avg. BOD (mg/l)	Dust and Dirt Avg. COD (mg/l)	Roadway Dust and Dirt Loading Rates: Dry Weather Samples[b] (No.)	Dry Weather Samples[b] (lb/day/100 ft)	Wet Weather Samples[c] (No.)	Wet Weather Samples[c] (lb/day/100 ft)	All Samples[d] (No.)	All Samples[d] (lb/day/100 ft)
1	Bus.	0.80	5.05	26.7	25	2.73	13	2.11	38	2.53
2	Bus.	2.04	4.03	24.8	29	7.00	16	4.72	45	6.19
4	Ind.	1.11	2.95	23.0	29	3.60	17	8.76	46	5.37
5	Res.	0	1.72	18.3	5	0.14	12	0.46	17	0.36
6	Res.	0.10	9.1	53.1	7	0.59	11	0.62	18	0.61
7	Res.	0.08	2.18	50.7	5	2.70	11	2.12	16	2.30
8	Res.	0.20	2.81	29.5	0	----	6	0.67	6	0.67
9	Res.	0.59	4.77	61.3	5	0.60	13	1.90	18	1.54
10	Res.	0.59	2.9	32.6	7	0.70	13	1.44	20	1.18
14	Res.	0	6.32	45.6	1	1.98	8	2.62	9	2.55
15	Res.	1.41	2.28	24.6	0	----	7	2.80	7	2.80
17	Res.	0	9.43	72.8	1	0.06	7	0.42	8	0.37
18	Res.	1.73	1.94	32.1	1	0.44	8	2.00	9	1.82
19	Res.	0	2.82	31.8	1	7.16	8	10.53	9	10.16
20	Res.	0.16	3.22	34.6	0	----	9	2.90	9	2.90

(a) All reported related data are included with the following exceptions: (a) data from areas 3 and 16 were excluded as no traffic estimates were reported, (b) data from areas 11 and 12 were not given in Reference 25, (c) APWA stated that data from area 13 may be regarded as nontypical.

(b) No significant amounts of rainfall occurred during accumulation of the "Dry Weather Samples."

(c) Precipitation was noted during accumulation of the "Wet Weather Samples."

(d) All samples, wet and dry weather, are grouped together.

TABLE 6. EFFECT OF TRAFFIC ON BOD AND COD IN ROADWAY DUST AND DIRT [(a)] (26)

$Y = A + BX$

Y = pounds of BOD or COD which accumulates each day per 1,000 feet of curb

A = intercept of the curb on the "Y" axis, lb BOD or COD/1,000 feet of curb/day

B = slope of the curve, lb BOD or COD/1,000 feet of curb/10,000 vehicles

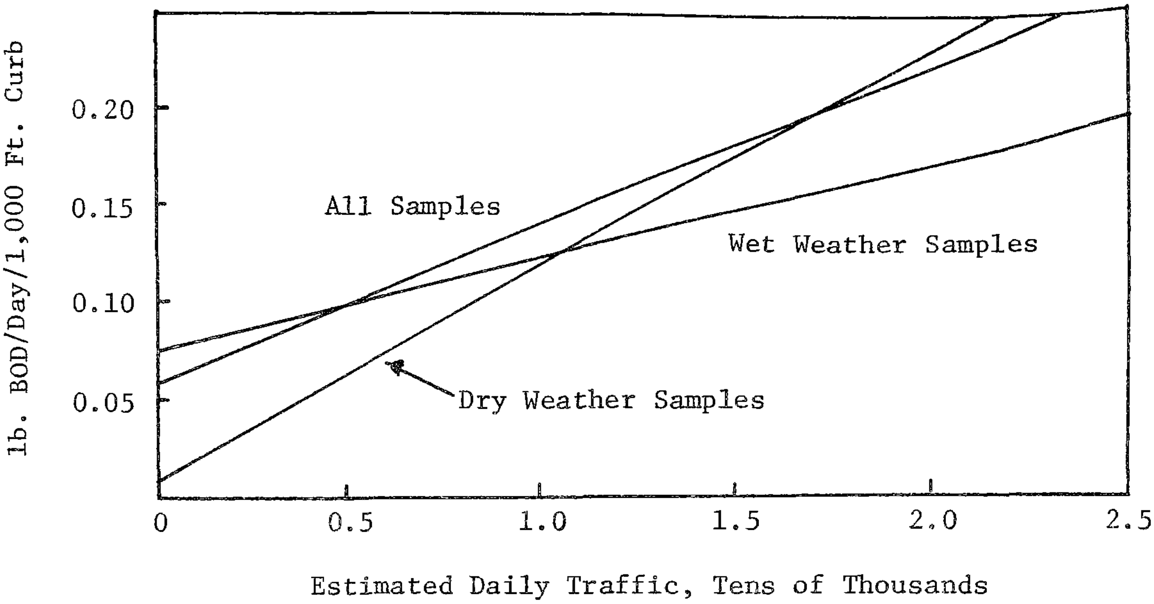
X = traffic intensity, ten thousands of vehicles per day

σ = standard deviation

R = correlation coefficient

BOD	A	B	2σ	R
1. Dry Weather Samples	0.0069	0.1235	0.094	0.87
2. Wet Weather Samples	0.0728	0.0493	0.167	0.39
3. All Samples	0.0596	0.0763	0.120	0.68
COD				
1. Dry Weather Samples	0.272	0.635	0.61	0.81
2. Wet Weather Samples	0.697	0.404	1.38	0.38
3. All Samples	0.139	0.931	1.42	0.71

(a) These values were computed by Biospherics Incorporated based upon APWA data in Reference (25).



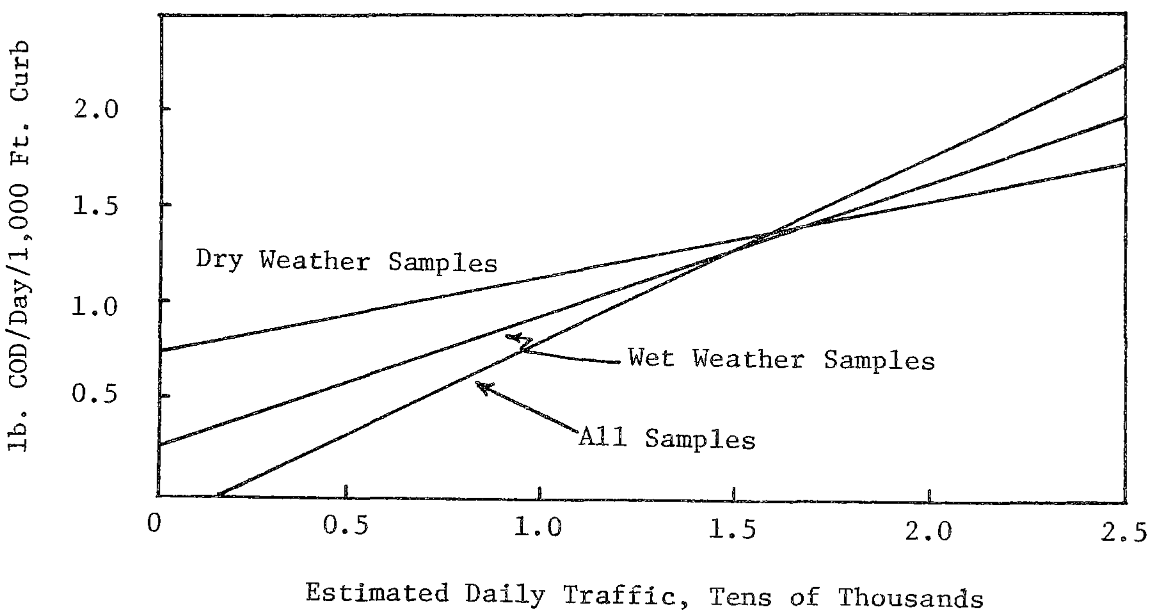


Figure 2. Effect of traffic on BOD and COD in Street Dust and Dirt[a] (26)

(a) Lines are least square representations computed by Biospherics Incorporated based on APWA data in Reference 25.

literature describes several unique characteristics of urban runoff not shared by sanitary sewage:

1. The COD-to-BOD ratios of urban runoff are much higher than for sanitary sewage.

2. Roadway dust and dirt as well as urban runoff contain large amounts of toxic materials - heavy metals, pesticides, and polychlorinated biphenyls.

3. Roadway deicing chemicals and abrasives applied during the winter are a significant contributor to loadings in urban runoff.

Examination of Tables 2 and 3 show COD/BOD ratios for urban stormwater ranging from five to 18, all much higher than the ratio of about 1.1 to 1.5 generally found in raw sanitary sewage. It is interesting to note that the ratio of roadway COD to BOD previously calculated from the APWA study (25) and attributed to vehicular traffic is approximately six. The URS Research Company study reported high COD/BOD ratios on roadway dust and dirt and stated that:

> It should be noted that while BOD's were run for many samples collected from street surfaces, the data should be viewed with some skepticism. This is primarily due to the fact that the presence of toxic materials can seriously interfere with measured BOD results. Such materials (particularly heavy metals) have been found to be present in many samples at levels far in excess of those known to cause substantial interference. Note that the interference is in the direction of yielding low results, so that our measurements should probably all be raised somewhat (by how much we would not speculate).
>
> The COD test provides a better basis for estimating the oxygen demand potential, primarily because it is not subject to interference by toxic materials (27).

Another investigator (28) has commented on the ratio found in separated and combined sewer discharges:

> "In view of the ratio of BOD to COD, depression of biological oxidation is suspected."

As suggested by the URS Research Company report, the observed ratios may be caused by depression of biological oxidation by toxic substances. Other possibilities may be that the samples contain a large inorganic oxidizable fraction, nonbiodegradible organic materials are present, or that insufficient seed organisms are present in the sample to complete the five-day BOD test. Dust and dirt BOD and COD values obtained to date under Biospherics' current EPA program confirm previously reported results. COD/BOD ratios in excess of 100 have been found in some samples (29).

The presence of toxic materials in urban stormwater has been pointed out by a number of investigators. A report of a study of the Potomac estuary cites significant increases in the heavy metals content of sediment samples taken near sewage outfalls (30). Although the authors attribute this to heavy metals in sewage treatment plant effluent, they state that urban runoff may also be responsible. Significant concentrations of particulate lead, but no soluble lead, were reported by E. E. Angino, et al in a study of runoff in Lawrence, Kansas (31). G. Soderlund, et al (32) found up to 100 mg/l of lead in snow and attributed this to motor vehicular traffic in a study conducted at Stockholm, Sweden. To date, the most extensive study conducted concerning the heavy metals content of roadway surface deposits has been reported by URS Research Company (33). Values found from studies in seven cities of the United States are shown in Table 7.

TABLE 7. HEAVY METALS CONTENT OF ROADWAY DUST AND DIRT (33)

City	Heavy Metats Content (μg/g)						
	Cd	Ni	Pb	Zn	Cu	Cr	Hg
San Jose, California	3.4	160	2000	1400	550	220	470
	---	14	150	47	3	23	14
Phoenix, Arizona	---	42	140	390	63	32	24
Milwaukee, Wisconsin	1.5	13	840	980	230	20	---
Baltimore, Maryland	2.8	87	630	1300	360	440	---
Atlanta, Georgia	---	49	180	260	150	24	52
Tulsa, Oklahoma	---	35	93	190	97	10	60
Seattle, Washington	---	61	1100	810	160	180	75
Numerical Mean	---	58	650	670	200	120	---

Pesticides as possible sources of pollutants in urban runoff were cited by APWA (34). A study in Cincinnati, Ohio, described by S. R. Weibel, et al (35) reported organic chlorine (a measure of chlorinated pesticide content) levels ranging from 0.38 to 4.72 μg/l in urban stormwater runoff. The organic chlorine levels found in rainfall collected in this area varied from 0.08 to 0.41 μg/l. Use of pesticides in urban areas was cited as a possible source in rainfall.

As with the heavy metals, the most extensive study to date of organic toxic components of street deposits was conducted by URS Research Company (33). Endrin, methoxychlor, lindane and the thiophosphate pesticide methyl parathion were each found in samples from one or more of the eight cities surveyed. DDD, p, p'-DDT and dieldrin were found in all eight cities at average levels of 72, 72 and 27 μg/g, respectively. Surprisingly, polychlorinated biphenyls were found in each of the cities at an average level of 530 μg/g. The discovery of these high levels of toxic materials, heavy metals and chlorinated organics, in urban stormwater runoff constitutes an extremely significant finding.

Highway deicing practices are another source of water contamination. The relatively inert sand and ash used as abrasives add suspended solids to stormwater runoff. A review of the literature on highway deicing found salt applied for this purpose to be a significant pollutant in water as well as a contributor to highway and vehicle deterioration. Specific studies have shown quite high salt levels:

> Runoff samples collected from a downtown Chicago expressway in the winter of 1967 showed chloride content from 11,000 to 25,000 mg/l. It has been calculated that 600 lbs. salt when applied to a one-mile section of roadway 20 feet wide containing 0.2 inches of ice, will produce an initial salt solution of 69,000 to 200,000 mg/l in the temperature range of 10°F - 25°F. At Milwaukee on January 16, 1969, extremely high chloride levels of 1,510 to 2,730 mg/l were found in the Milwaukee, Menomonee and Kinnickinnic Rivers, (sic) believed directly attributable to deicing salts entering these streams via snow melt. The dumping of extremely large amounts of accumulated snow and ice from streets and highways, either directly or indirectly into nearby waterbodies, could constitute a serious pollution problem. These deposits have been shown to contain up to 10,000 mg/l sodium chloride, 100 mg/l oils and 100 mg/l lead (36)

A study in Boston (37) found that "Salt concentrations may be of some concern to persons on low sodium diets and to persons who obtain water from wells in the vicinity of major highways where salt concentrations could be several times higher than average."

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions may be drawn from the literature reviewed herein:

1. The pollutional load imposed on receiving waters by urban runoff is significant on a shock load basis, and, in most cases, on a yearly basis.

2. All or a portion of runoff from urban areas must be treated or reduced if water quality of the receiving waters is to be protected.

3. During portions of the runoff event, the concentrations of pollutants in urban runoff may be higher than those of sanitary sewage.

4. During some portions of the runoff period, generally after long periods of rainfall, the concentration of pollutants is low enough so that only moderate or no treatment is required.

5. The contribution of streets and roadways to urban runoff pollution is significant; and, based upon statistical analyses of

the limited amount of data available, the contribution of motor vehicular traffic is of major importance.

6. Computerized mathematical models devised to predict the quality and quantity of overflow from combined and separate sewer systems in urban areas have been successfully tested.

7. Urban stormwater runoff differs qualitatively from sanitary sewage in two important and, perhaps, related aspects:

   a. Stormwater runoff contains significant concentrations of heavy metals and toxic organic compounds.

   b. The COD/BOD ratios for urban stormwater runoff are much higher than those of sanitary sewage.

As a result of the literature review, we have become aware of a number of gaps in existing knowledge and technology required for solving the problems associated with urban stormwater runoff. On this basis, additional studies are recommended in the following areas:

1. Studies are required to establish the quality and quantity of urban runoff from various types of storm sewer systems. Hydrological data should be factored into these studies in order that variations in temporal distributions of these parameters can be studied as a function of differing intensities and durations of precipitation. Specific factors in drainage systems which affect the concentration and total load versus time curves should be studied. These studies may permit the design and construction of new urban area sewer systems which will reduce the volume of runoff which must be treated.

2. Development of storage systems to contain stormwater runoff should be undertaken.

3. The effects of stormwater upon conventional types of sewage treatment processes should be investigated under conditions of normal runoff and continuous feed from a storage facility.

4. Special wastewater treatment processes should be developed for stormwater from combined and storm sewer systems.

5. Potential for reuse of treated water should be evaluated.

6. A detailed investigation should be made of the kinds and amounts of toxic materials found in urban runoff. The impact of toxic materials on receiving water should be studied.

7. The specific contributions and potential hazards of motor vehicular traffic to urban runoff should be investigated and recommendations made to reduce this contribution.

8. The possibility that hazardous levels of toxic materials or microorganisms from urban runoff might be induced in potable water supply sources should be investigated.

9. The capability of conventional potable water treatment plants to reduce possible excessive levels of refractory components of urban runoff in water supply sources should be investigated.

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APPENDIX I

PARTICLE SIZE DISTRIBUTION AND ANALYSIS

TABLE I-1. PARTICLE SIZE DISTRIBUTION OF ROADWAY SAMPLES DUST AND DIRT

Sample Description			Particle Size (u)															
No.	Location	Type	3350-1700		1700-850		850-420		420-250		250-150		150-75		75-45		45-	
			wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%
1-D	I-95	Initial	6.8	2.5	1.7	1.0	5.1	1.3	13.0	6.4	21.3	12.8	31.1	33.2	19.8	39.6	1.2	3.2
2-D	I-95	1-day	2.3	1.2	10.8	5.7	8.0	1.2	10.6	11.5	11.0	11.5	17.9	11.5	11.6	11.6	27.8	45.9
7-D	Ken. Av.-Right	Initial	16.1	32.6	16.5	26.1	20.7	17.9	21.0	8.1	13.5	6.5	8.4	4.9	2.3	1.6	1.5	1.3
10-D	Ken. Av.-Right	1-day	9.6	20.0	12.2	16.0	20.9	16.0	23.6	14.4	16.9	16.0	9.8	8.0	3.4	5.6	3.6	4.0
13-D	Ken. Av.-Right	1-day	7.7	0.2	8.5	12.0	21.6	22.0	30.3	30.4	17.6	15.3	10.5	9.2	2.5	1.3	1.3	0.6
14-D	Ken. Av.-Left	Initial	31.5	32.6	15.3	14.0	16.2	16.8	15.1	14.0	9.0	7.4	6.4	5.6	2.6	4.0	2.9	5.6
19-D	Ken. Av.-Left	Weekend	12.9	16.6	13.6	12.5	24.8	25.0	25.8	25.8	13.5	12.0	7.4	7.5	1.4	0.5	0.6	0.1
20-D	Ken. Av.-Left	1-day	13.0	14.4	9.6	10.2	19.9	19.7	25.5	25.4	16.1	14.3	11.2	10.2	2.8	3.3	1.9	2.5
21-D	I-495	Initial	4.9	4.7	5.7	5.1	11.0	7.0	16.9	13.4	20.2	17.4	20.1	29.5	15.2	14.8	6.0	8.1
22-D	I-495	1-day	4.2	4.0	5.2	4.8	11.2	7.6	19.4	19.6	20.9	20.8	23.0	23.6	10.2	10.4	5.9	9.2
26-D	I-495	1-day	4.6	3.2	6.8	7.0	15.5	14.7	22.3	19.1	20.8	22.1	19.5	21.4	7.9	8.1	2.6	4.4
27-D	Loehmann's	Initial	0.3	0.4	4.0	4.4	17.2	15.4	25.7	23.8	16.2	14.1	19.5	19.8	10.3	11.5	6.8	10.6
31-D	Loehmann's	1-day	1.0	1.3	4.9	5.3	23.1	19.8	25.7	21.1	14.2	13.2	16.3	19.5	10.2	13.2	4.6	6.6
32-D	Loehmann's	1-day	2.1	0.7	5.0	4.1	6.6	22.7	31.5	24.9	18.9	15.9	20.1	16.8	9.5	8.1	6.3	6.8
33-D	Ken. Av.-Right	Initial	14.3	15.8	17.7	21.6	24.7	25.1	22.6	18.7	12.7	11.8	6.6	6.5	1.2	0.4	0.2	0.1
34-D	Ken. Av.-Right	1-day	12.9	11.1	14.5	11.1	19.6	17.9	20.4	22.2	17.0	22.2	9.8	11.1	3.0	2.2	2.8	2.2
35-D	Ken. Av.-Right	1-day	7.1	1.4	11.8	7.0	20.5	16.9	25.7	28.2	17.5	35.2	13.1	8.5	2.9	1.4	1.4	1.4

TABLE I-1 (CONTINUED). PARTICLE SIZE DISTRIBUTION OF ROADWAY SAMPLES
DUST AND DIRT

Sample Description			Particle Size (u)															
No.	Location	Type	3350-1700		1700-850		850-420		420-250		250-150		150-75		75-45		45-	
			wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%
37-D	Ken. Av.-Left	Initial	12.3	11.2	12.7	13.7	22.6	24.4	25.8	26.6	15.1	15.5	8.1	7.5	2.2	0.7	1.2	0.4
38-D	Ken. Av.-Left	1-day	9.6	4.6	12.9	11.5	24.8	25.3	24.6	24.0	13.6	22.1	9.4	11.5	2.4	0.5	2.7	0.5
39-D	Ken. Av.-Left	1-day	10.6	8.9	12.1	16.4	22.1	24.0	25.8	24.7	16.0	16.4	9.6	8.6	2.3	0.7	1.5	0.3
41-D	I 495	Initial	10.6	6.9	14.0	16.7	21.5	20.8	23.6	24.7	16.2	17.0	11.2	13.4	2.0	0.4	0.9	0.1
43-D	I 495	1-day	4.1	2.9	7.4	5.9	18.2	17.4	26.6	25.9	20.6	20.6	15.9	15.3	4.1	8.5	3.1	3.5
44-D	I 495	Weekend	4.3	2.4	9.0	8.9	20.0	20.7	24.4	23.7	17.5	17.3	17.0	17.8	4.9	4.9	2.9	4.3
47-D	Loehmann's	Initial	2.0	1.4	6.4	6.3	23.1	21.5	25.3	25.0	16.0	14.6	17.2	18.1	6.3	6.9	3.7	6.2
49-D	Loehmann's	Weekend	2.8	6.8	8.4	18.0	25.6	24.3	23.5	17.0	15.4	11.2	10.3	11.6	10.2	7.7	3.8	3.4
50-D	Loehmann's	1-day	2.5	2.6	9.0	7.9	22.5	34.4	20.4	25.4	11.8	7.9	15.0	10.6	18.2	10.6	0.6	0.6
51-D	CAMP Station	Initial	4.6	4.8	7.8	10.6	17.8	19.4	22.9	24.7	14.8	14.5	14.9	16.0	16.3	9.7	0.9	0.3
53-D	CAMP Station	1-day	9.0	8.2	9.8	10.1	20.4	20.1	27.6	27.6	17.7	18.2	12.4	12.6	2.8	3.1	0.3	0.1
55-D	CAMP Station	Weekend	4.9	4.0	5.7	5.0	17.6	18.1	24.8	20.2	16.4	15.1	19.9	23.2	10.4	14.1	0.3	0.3
56-D	N. Cap.-Right	Initial	1.7	0.3	3.6	0.8	18.5	19.4	30.8	29.2	23.2	24.2	16.1	17.8	5.5	8.1	0.6	0.2
59-D	N. Cap.-Right	Weekend	2.2	1.4	7.4	7.2	22.4	21.7	26.4	25.3	23.6	23.8	14.8	16.6	2.6	3.6	0.6	0.4
60-D	N. Cap.-Right	1-day	3.7	2.0	6.9	4.0	18.2	13.9	20.4	19.9	17.4	17.9	22.8	29.9	10.0	12.0	0.6	0.4

TABLE I-1 (CONTINUED). PARTICLE SIZE DISTRIBUTION OF ROADWAY SAMPLES
DUST AND DIRT

Sample Description			Particle Size (u)															
No.	Location	Type	3350-1700		1700-850		850-420		420-250		250-150		150-75		75-45		45-	
			wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%	wt.%	v.%
61-D	Ken. Av.-Right	Initial	10.6	9.1	14.9	14.2	23.1	22.7	18.7	17.0	12.6	11.9	10.2	11.4	6.6	9.1	3.3	4.6
62-D	Ken. Av.-Right	1-day	11.0	12.7	15.1	18.9	24.1	30.4	22.8	12.7	14.2	12.7	8.7	8.8	2.4	2.5	1.7	1.3
66-D	Ken. Av.-Right	Weekend	12.3	6.8	17.9	18.8	21.8	22.3	18.8	17.1	13.3	15.4	11.6	15.4	3.3	3.4	1.0	0.8
67-D	Ken. Av.-Left	Initial	5.9	5.5	8.8	9.1	29.1	27.3	29.6	28.5	16.9	19.7	7.1	7.2	2.2	2.4	0.4	0.3
68-D	Ken. Av.-Left	1-day	6.4	4.7	10.2	9.3	19.9	19.4	24.7	25.8	15.5	14.8	13.6	13.9	8.7	12.0	1.0	0.1
72-D	Ken. Av.-Left	Weekend	8.1	8.7	12.9	13.4	25.8	20.1	26.7	28.7	14.5	15.3	8.8	10.5	2.6	2.9	0.6	0.4
79-D	N. Cap.-Right	1-day	3.9	3.8	7.5	7.9	18.9	17.5	23.3	20.6	17.1	15.9	18.6	19.1	9.2	12.7	1.5	2.5
82-D	N. Cap.-Right	4-day	2.4	2.7	6.2	6.6	21.8	19.9	31.5	31.8	20.6	21.2	10.1	9.3	6.9	8.0	0.5	0.5
83-D	N. Cap.-Right	1-day	4.5	4.2	11.8	10.5	19.6	17.5	20.2	18.2	15.4	15.7	20.2	22.7	7.7	10.5	0.4	0.7
85-D	N. Cap.-Right	1-day	3.0	4.1	6.1	6.1	17.9	16.4	26.8	25.6	18.9	18.5	17.9	18.5	7.6	0.2	0.9	1.6
88-D	N. Cap.-Left	4-day	3.2	3.4	6.0	6.7	16.1	15.2	22.5	20.2	19.9	18.5	22.1	23.5	9.8	11.8	0.4	0.7
89-D	N. Cap.-Left	1-day	4.6	4.5	8.4	8.7	20.8	19.0	24.6	22.5	15.9	15.6	16.1	17.3	9.3	12.1	0.3	0.3
92-D	CAMP Station	1-day	4.1	3.7	8.0	8.8	20.1	21.3	21.7	20.0	16.7	13.7	18.2	16.3	10.2	13.7	1.0	2.5
93-D	CAMP Station	1-day	5.7	5.9	9.1	9.3	18.2	16.3	19.9	17.4	15.7	15.1	18.1	17.4	11.6	15.1	1.7	3.5
94-D	CAMP Station	1-day	4.6	4.2	7.3	7.3	17.7	16.7	21.2	19.8	16.6	15.6	18.8	18.7	12.3	14.6	1.5	3.1
96-D	Balt-Wash.	1-day	5.3	5.7	7.7	7.6	14.1	13.5	16.0	15.4	14.1	13.5	18.8	15.4	11.2	13.5	12.8	15.4
97-D	Balt-Wash.	1-day	9.7	12.5	10.3	12.5	13.4	12.5	13.2	12.5	12.5	12.5	19.2	18.7	13.4	12.5	8.3	6.3
98-D	Balt-Wash.	1-day	11.2	15.4	10.8	15.4	15.7	15.4	13.8	15.4	10.4	7.7	13.5	7.7	15.6	15.4	9.0	7.6

TABLE I-2. ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 1

Particle Size (microns)	Dry Weight (g)	Dry Weight (%)	Dry Volume (ml)	Dry Volume (%)	Volatile Solids (mg/g)	BOD (mg/g)	COD (mg/g)	Grease (mg/g)
Sample 13 D, Kenilworth Avenue, Right, 8 Aug. 1972								
3350-850	183.5	16.2	130	16.3	75.2	2.11	26.5	10.3
850-420	244.6	21.6	173	21.6	32.6	2.33	26.3	4.7
420-250	343.2	30.3	242	30.3	38.9	1.84	29.3	4.2
250- 75	318.2	28.1	225	28.1	29.7	2.72	56.7	7.3
75-	43.0	3.8	30	3.8	106.1	4.56	142.7	20.1
Sample 20 D, Kenilworth Avenue, Left, 8 Aug. 1972								
3350-850	410.7	22.6	295.2	24.6	98.8	1.84	45.7	6.0
850-420	361.6	19.9	236.4	19.7	26.5	2.29	45.0	5.2
420-250	463.3	25.5	304.8	25.4	24.9	2.90	38.0	5.7
250- 75	496.1	27.3	294.0	24.5	40.1	3.26	66.8	5.7
75-	85.4	4.7	69.6	5.8	91.1	5.78	170.9	17.6
Sample 22 D, I-495, 15 Aug. 1972								
3350-850	176.7	9.4	114.4	8.8	37.2	2.83	61.1	9.0
850-420	210.0	11.1	98.8	7.6	31.0	1.85	87.5	6.3
420-250	364.9	19.4	254.8	19.6	22.6	2.24	81.5	7.3
250- 75	827.7	44.0	577.2	44.4	49.7	2.79	141.7	13.1
75-	303.7	16.1	254.8	19.6	72.4	3.55	180.8	21.5
Sample 31 D, Loehmann's Plaza, 18 Sep. 1972								
3350-850	45.1	5.9	36.3	6.6	45.3	3.04	15.7	6.7
850-420	176.6	23.1	108.9	19.8	43.4	2.29	65.0	2.4
420-250	196.5	25.7	116.0	21.1	38.6	2.60	45.8	3.1
250- 75	233.2	30.5	179.9	32.7	121.6	4.10	160.8	21.3
75-	113.1	14.8	108.9	19.8	219.8	9.23	336.2	51.5

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 1

Particle Size (microns)	Dry Weight (g)	Dry Weight (%)	Dry Volume (ml)	Dry Volume (%)	Volatile Solids (mg/g)	BOD (mg/g)	COD (mg/g)	Grease (mg/g)
Sample 34 D, Kenilworth Avenue, Right, 26 Sep. 1972								
3350-850	69.2	27.4	54.4	22.2	86.9	3.35	65.1	6.6
850-420	49.5	19.6	43.9	17.9	38.5	4.40	53.3	8.0
420-250	51.5	20.4	54.4	22.2	57.7	2.98	49.3	13.8
250- 75	67.6	26.8	81.6	33.3	57.0	4.21	104.3	8.9
75-	14.6	5.8	10.7	4.4	116.9	5.14	204.1	23.0
Sample 38 D, Kenilworth Avenue, Left, 26 Sep. 1972								
3350-850	145.6	22.5	72.4	16.1	53.0	1.53	36.3	6.3
850-420	160.5	24.8	113.9	25.3	32.3	1.72	51.0	4.4
420-250	159.2	24.6	108.0	24.0	26.2	1.91	39.0	4.5
250- 75	148.9	23.0	151.2	33.6	32.9	2.60	94.8	8.0
75-	33.0	5.1	4.5	1.0	113.8	5.90	191.5	16.3
Sample 43 D, I-495, 18 Oct. 1972								
3350-850	241.3	11.5	118.8	8.8	37.4	1.57	75.0	6.2
850-420	381.8	18.2	234.9	17.4	27.5	2.96	26.4	2.7
420-250	558.0	26.6	349.6	25.9	30.0	2.18	24.6	4.2
250- 75	765.8	36.5	484.7	35.9	48.9	3.19	57.6	7.6
75-	151.1	7.2	162.0	12.0	83.5	5.19	141.6	14.2
Sample 50 D, Loehmann's Plaza, 7 Nov. 1972								
3350-850	34.9	11.5	29.4	10.5	213.7	17.20	200.3	20.3
850-420	68.3	22.5	96.3	34.4	163.0	9.19	111.7	17.8
420-250	61.9	20.4	71.1	25.4	74.8	11.58	120.5	14.3
250- 75	81.3	26.8	51.8	18.5	113.5	10.10	186.5	33.7
75-	57.1	18.8	31.4	11.2	251.3	14.05	239.6	43.4

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 1

Particle Size (microns)	Dry Weight (g)	Dry Weight (%)	Dry Volume (ml)	Dry Volume (%)	Volatile Solids (mg/g)	BOD (mg/g)	COD (mg/g)	Grease (mg/g)
Sample 53 D, CAMP Station, 9 Nov. 1972								
3350-850	590.5	18.8	306.5	18.3	57.2	3.22	89.0	13.2
850-420	640.7	20.4	336.7	20.1	35.7	2.72	61.6	6.2
420-250	866.9	27.6	462.3	27.6	26.5	2.59	52.1	8.1
250- 75	945.4	30.1	515.9	30.8	48.3	2.77	97.0	24.2
75-	97.4	3.1	53.6	3.2	94.5	6.69	194.2	43.4
Sample 60 D, North Capitol Street, Right, 5 Dec. 1972								
3350-850	52.8	10.6	21.0	6.0	102.8	1.92	44.4	5.3
850-420	90.6	18.2	48.7	13.9	30.8	1.57	38.7	4.7
420-250	101.5	20.4	69.7	19.9	29.7	2.74	42.0	4.5
250- 75	200.0	40.2	167.3	47.8	69.0	3.21	139.1	17.1
75-	52.7	10.6	43.3	12.4	125.7	9.08	373.6	47.1
Sample 85 D, North Capitol Street, Left, 6 Feb. 1973								
3350-850	75.8	10.0	45.9	10.2	31.7	2.26	49.7	7.4
850-420	135.7	17.9	73.8	16.4	22.0	2.04	34.2	3.5
420-250	203.2	26.8	115.2	25.6	19.0	2.19	37.0	2.9
250- 75	279.0	36.8	166.5	37.0	45.9	4.23	69.4	15.3
75-	64.4	8.5	48.6	10.8	135.3	7.80	181.1	40.3
Sample 96 D, Baltimore Washington Parkway, 9 March 1973								
3350-850	52.0	13.0	46.6	13.3	73.8	2.79	100.7	10.5
850-420	56.4	14.1	47.3	13.5	36.8	2.44	67.2	11.1
420-250	64.0	16.0	53.9	15.4	20.9	1.53	55.0	4.2
250- 75	131.5	32.9	101.2	28.9	54.5	2.42	101.9	11.4
75-	96.0	24.0	101.2	28.9	97.1	5.92	178.4	18.9

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 2

Particle Size (microns)	Total PO_4-P (mg/g)	PO_4-P (mg/g)	NO_3-N (ug/g)	NO_2-N (ug/g)	Kjeld. N (mg/g)	Cl (mg/g)	CN (mg/g)	Petrol. (mg/g)	n-Par. (mg/g)	Fecal Coliform (org./g)	Fecal Strep. (org./g)	Asbestos (fbrs/g) $x10^{-5}$	Rubber mg/g
Sample 13 D, Kenilworth Avenue, Right, 8 Aug. 1972													
3350-850	0.390	0.035	18.5	0.15	0.31	0.24	-	4.9	3.6	0	0	0.0	0.9
850-420	0.146	0.047	19.9	0.11	0.62	0.42	-	3.3	2.6	0	0	0.8	0.8
420-250	0.116	0.042	20.7	0.03	0.25	1.00	-	2.8	2.5	0	0	0.5	0.6
250- 75	0.222	0.044	21.0	0.02	0.57	0.36	-	4.5	3.3	0	0	0.6	4.4
75-	0.412	0.091	42.0	0.15	1.73	0.32	-	12.9	10.9	0	0	0.6	10.0
Sample 20 D, Kenilworth Avenue, Left, 8 Aug. 1972													
3350-850	0.146	0.000	7.4	0.08	0.32	0.21	-	4.4	3.5	0	0	0.6	0.2
850-420	0.173	0.000	3.5	0.09	0.25	0.10	-	2.8	2.4	0	0	2.9	1.4
420-250	0.171	0.000	8.4	0.04	0.19	0.15	-	3.4	2.8	0	0	1.3	1.6
250- 75	0.256	0.000	18.8	0.03	0.34	0.16	-	4.1	2.9	0	0	0.0	2.9
75-	0.329	0.000	32.7	0.03	0.91	0.33	-	13.4	9.4	0	0	0.6	9.0
Sample 22 D, I-495, 15 Aug. 1972													
3350-850	0.112	0.000	5.8	0.11	0.42	0.23	-	4.9	3.1	0	0	0.0	0.2
850-420	0.257	0.000	9.1	0.14	0.39	0.38	-	3.2	2.2	0	0	0.1	0.4
420-250	0.244	0.000	10.9	0.15	0.26	0.55	-	3.8	2.5	0	0	0.1	0.4
250-75	0.434	0.000	14.0	0.15	0.48	0.56	-	6.3	5.5	0	0	0.3	0.8
75-	0.458	0.094	96.1	0.08	0.96	0.86	-	9.8	9.0	0	0	0.6	1.4

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 2

Particle Size (microns)	Total PO_4-P (mg/g)	PO_4-P (mg/g)	NO_3-N (ug/g)	NO_2-N (ug/g)	Kjeld. N (mg/g)	Cl (mg/g)	CN (mg/g)	Petrol. (mg/g)	n-Par. (mg/g)	Fecal Coliform (org./g)	Fecal Strep. (org./g)	Asbestos (fbrs/g) $x10^{-5}$	Rubber mg/g
Sample 31 D, Loehmann's Plaza, 18 Sept. 1972													
3350-850	0.093	0.101	41.3	0.04	0.75	0.23	-	6.0	5.7	0	0	0.2	0.5
850-420	0.051	0.005	13.1	0.04	1.39	0.25	-	1.6	1.3	0	0	0.5	1.3
420-250	0.138	0.004	8.6	0.05	0.56	0.25	-	2.0	1.0	0	0	3.2	0.8
250- 75	0.214	0.001	21.9	0.04	0.46	0.29	-	9.0	8.2	0	0	2.5	10.8
75-	0.427	0.001	44.1	0.12	0.72	0.64	-	20.3	13.9	0	0	6.4	75.6
Sample 34 D, Kenilworth Avenue, Right, 26 Sep. 1972													
3350-850	0.378	0.045	15.2	0.01	0.36	0.22	-	3.7	2.5	-	-	1.3	1.0
850-420	0.292	0.060	24.6	0.01	0.65	0.26	-	4.3	2.8	-	-	0.6	1.6
420-250	0.256	0.047	18.2	0.00	0.24	0.25	-	3.1	2.0	-	-	0.0	2.2
250- 75	0.384	0.078	13.4	0.01	0.16	0.27	-	5.1	3.8	-	-	2.6	2.6
75-	0.488	0.015	24.6	0.01	0.34	1.30	-	15.3	11.8	-	-	0.0	24.6
Sample 38 D, Kenilworth Avenue, Left, 26 Sep. 1972													
3350-850	0.098	0.004	14.8	0.03	1.36	0.20	-	4.7	3.2	-	-	0.0	0.4
850-420	0.146	0.044	23.7	0.01	0.25	0.17	-	2.5	2.4	-	-	1.3	0.5
420-250	0.144	0.040	25.8	0.01	0.25	0.19	-	4.0	0.9	-	-	0.6	1.4
250- 75	0.210	0.025	31.0	0.10	0.56	0.37	-	4.4	4.3	-	-	3.8	2.6
75-	0.295	0.032	48.6	0.01	1.23	0.46	-	12.2	10.4	-	-	1.3	7.5

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 2

Particle Size (microns)	Total PO_4-P (mg/g)	PO_4-P (mg/g)	NO_3-N (ug/g)	NO_2-N (ug/g)	Kjeld. N (mg/g)	Cl (mg/g)	CN (mg/g)	Petrol. (mg/g)	n-Par. (mg/g)	Fecal Coliform (org./g)	Fecal Strep. (org./g)	Asbestos (fbrs/g) $x10^{-5}$	Rubber mg/g
Sample 43 D, I-495, 18 Oct. 1972													
3350-850	0.244	0.000	13.4	0.03	0.90	1.80	-	5.0	2.5	-	-	0.5	0.6
850-420	0.238	0.000	11.6	0.01	0.35	1.82	-	2.9	2.6	-	-	5.8	1.5
420-250	0.250	0.000	24.3	0.00	0.14	1.17	-	3.3	2.2	-	-	3.2	1.5
250- 75	0.242	0.000	42.0	0.00	0.22	1.20	-	5.0	3.6	-	-	5.1	6.7
75-	0.315	0.000	40.1	0.30	0.32	1.63	-	9.1	6.6	-	-	0.0	10.8
Sample 50 D, Loehmann's Plaza, 7 Nov. 1972													
3350-850	0.122	0.042	16.0	0.00	1.14	0.73	-	5.0	3.3	-	-	0.0	1.0
850-420	0.193	0.031	7.5	0.00	1.08	0.63	-	5.4	3.3	-	-	0.5	1.0
420-250	0.295	0.047	9.7	0.00	0.89	0.46	-	5.4	3.6	-	-	2.6	1.9
250- 75	0.234	0.052	17.1	0.00	1.26	0.46	-	8.3	6.2	-	-	5.1	8.0
75-	0.427	0.012	13.6	0.06	1.37	0.69	-	25.4	19.0	-	-	0.0	19.6
Sample 53 D, CAMP Station, 9 Nov. 1972													
3350-850	0.095	0.007	13.4	0.05	0.75	0.25	-	5.2	3.3	-	-	0.5	0.1
850-420	0.107	0.008	10.2	0.01	0.63	0.15	-	2.4	1.9	-	-	2.6	0.1
420-250	0.100	0.007	10.0	0.00	0.30	0.04	-	4.0	3.0	-	-	3.2	0.3
250- 75	0.238	0.002	20.1	0.01	0.28	0.21	-	13.2	8.9	-	-	2.6	0.6
75-	0.381	0.001	43.8	0.11	0.35	0.89	-	25.7	18.8	-	-	0.0	5.2

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 2

Particle Size (microns)	Total PO_4-P (mg/g)	PO_4-P (mg/g)	NO_3-N (ug/g)	NO_2-N (ug/g)	Kjeld. N (mg/g)	Cl (mg/g)	CN (mg/g)	Petrol. (mg/g)	n-Par. (mg/g)	Fecal Coliform (org./g)	Fecal Strep. (org./g)	Asbestos (fbrs/g) $x10^{-5}$	Rubber mg/g
Sample 60 D, North Capitol Street, Right, 5 Dec. 1972													
3350-850	0.173	0.017	10.9	0.00	0.50	0.20	-	2.7	2.4	0	400	0.6	0.2
850-420	0.110	0.015	11.2	0.00	2.35	0.26	-	1.9	1.6	0	50	1.5	0.7
420-250	0.092	0.020	7.4	0.00	1.95	0.31	-	2.2	2.0	0	100	1.3	0.9
250- 75	0.193	0.026	13.9	0.01	0.85	0.69	-	10.3	10.0	0	1250	1.9	6.6
75-	0.287	0.001	25.8	0.09	0.45	1.54	-	25.7	24.7	0	2025	0.0	27.4
Sample 85 D, North Capitol Street, Left, 6 Feb. 1973													
3350-850	0.134	0.001	4.3	0.01	0.21	0.16	-	4.2	4.1	-	-	2.6	2.1
850-420	0.146	0.008	8.5	0.01	0.15	0.14	-	3.0	2.9	-	-	0.0	1.6
420-250	0.152	0.015	10.3	0.00	0.21	0.18	-	3.5	3.3	-	-	0.0	2.0
250- 75	0.250	0.009	21.3	0.01	0.45	0.30	-	8.5	7.0	-	-	0.0	3.6
75-	0.469	0.000	36.5	0.03	1.48	0.71	-	20.7	17.8	-	-	0.0	7.8
Sample 96 D, Baltimore Washington Parkway, 9 March 1973													
3350-850	0.256	0.009	12.8	0.01	0.45	0.52	-	4.3	3.8	-	-	1.9	0.9
850-420	0.266	0.010	10.3	0.01	0.32	0.27	-	4.0	2.5	-	-	1.3	1.6
420-250	0.229	0.007	8.5	0.01	0.20	0.34	-	2.3	1.9	-	-	2.6	4.0
250- 75	0.427	0.000	10.3	0.01	0.08	0.57	-	7.7	6.2	-	-	2.6	4.2
75-	0.420	0.106	28.9	0.01	0.16	0.91	-	12.7	11.4	-	-	5.1	14.4

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 3

Particle Size (microns)	Lead (ug/g)	Chromium (ug/g)	Nickel (ug/g)	Zinc (ug/g)	Copper (ug/g)	Cadmium (ug/g)	Barium (ug/g)
Sample 13 D, Kenilworth Avenue, Right, 8 Aug. 1972							
3350-850	905	23	85	217	89	-	58
850-420	1840	22	33	708	67	-	0
420-250	908	11	0	1040	37	-	0
250- 75	8570	56	217	2570	412	-	199
<75-	5070	34	67	1480	105	-	81
Sample 20 D, Kenilworth Avenue, Left, 8 Aug. 1972							
3350-850	370	9	53	251	35	-	0
850-420	1610	19	24	918	39	-	56
420-250	3360	18	18	692	156	-	0
250- 75	4820	19	42	1350	106	-	0
<75-	9680	44	115	2490	326	-	190
Sample 22 D, I-495, 15 Aug. 1972							
3350-850	1440	21	83	102	51	-	0
850-420	3760	22	90	764	283	-	0
420-250	9100	21	33	1920	56	-	0
250- 75	20260	32	73	3460	129	-	122
<75-	25900	55	233	2710	308	-	188
Sample 31 D, Loehmann's Plaza, 18 Sep. 1972							
3350-850	391	74	22	82	29	-	0
850-420	377	56	0	931	0	-	0
420-250	767	70	79	1530	27	-	0
250- 75	6390	205	240	1990	117	-	135
<75-	3370	95	77	1490	48	-	0
Sample 34 D, Kenilworth Avenue, Right, 26 Sep. 1972							
3350-850	284	53	166	542	63	4	-
850-420	4150	70	98	4140	357	3	-
420-250	2670	65	74	4140	241	3	-
250- 75	2740	89	106	4330	119	4	-
<75-	809	35	68	732	75	2	-
Sample 38 D, Kenilworth Avenue, Left, 26 Sept. 1972							
3350-850	900	110	226	94	57	2	-
850-420	9900	69	77	42	67	0	-
420-250	5810	79	104	535	45	4	-
250- 75	12800	99	100	1230	116	3	-
<75-	4500	161	244	1890	310	7	-

TABLE I-2 (CONTINUED). ANALYSES OF ROADWAY DUST AND DIRT AS A FUNCTION OF PARTICLE SIZE - PART 3

Particle Size (microns)	Lead (ug/g)	Chromium (ug/g)	Nickel (ug/g)	Zinc (ug/g)	Copper (ug/g)	Cadmium (ug/g)	Barium (ug/g)
Sample 43 D, I-495, 18 Aug. 1972							
3350-850	2360	111	275	154	43	2	-
850-420	5840	121	203	403	42	2	-
420-250	13400	191	141	909	163	3	-
250- 75	7400	175	138	973	71	2	-
<75-	16700	303	228	1530	183	5	-
Sample 50 D, Loehmann's Plaza, 7 Sep. 1972							
3350-850	48	26	103	34	18	0	-
850-420	595	148	153	579	23	4	-
420-250	1460	175	216	1780	62	1	-
250- 75	911	164	238	2040	94	4	-
<75-	1180	435	369	1310	170	5	-
Sample 53 D, CAMP, 9 Sep. 1972							
3350-850	856	427	1180	542	51	1	-
850-420	1990	132	166	384	36	0	-
420-250	294	92	100	239	17	2	-
250- 75	428	139	132	259	85	2	-
<75-	1340	298	238	671	214	5	-
Sample 60 D, North Capitol Street, Right, 5 Dec. 1972							
3350-850	255	84	179	93	54	0	-
850-420	285	4	69	1840	25	0	-
420-250	237	34	47	3550	28	0	-
250- 75	237	88	144	2590	97	0	-
<75-	5330	202	378	2010	191	3	-
Sample 85 D, North Capitol Street, Left, 6 Feb. 1973							
3350-850	63	117	406	42	32	1	-
850-420	1050	69	194	512	25	2	-
420-250	946	37	263	1310	15	1	-
250- 75	2520	101	119	976	49	3	-
<75-	2770	160	363	1290	138	5	-
Sample 96 D, Baltimore Washington Parkway, 9 Mar. 1973							
3350-850	1840	83	294	697	56	3	-
850-420	2000	66	91	1000	56	2	-
420-250	2310	58	206	1600	37	3	-
250- 75	3540	99	138	1290	224	3	-
<75-	476	53	194	1170	180	6	-

APPENDIX J

BLOW-IN EXPERIMENT

TABLE J-1. BLOW-IN EXPERIMENT - LITTER

Location	Date	Section (#)	Dry Weight (g)	Dry Volume (ml)	Volatile Solids (mg/g)	COD (mg/g)
Ken. Av. Right	5 Oct. '72	1	47.8	75	27.2	439.2
Ken. Av. Right	5 Oct. '72	2	38.6	80	273.1	319.4
Ken. Av. Right	5 Oct. '72	3	84.2	250	498.6	148.7
Ken. Av. Right	5 Oct. '72	4	37.4	150	375.2	215.5
Ken. Av. Right	5 Oct. '72	5	49.4	80	240.9	201.2
Ken. Av. Right	5 Oct. '72	6	46.5	75	329.3	148.6
Ken. Av. Right	6 Oct. '72	1	54.6	80	990.0	161.1
(a)Ken. Av. Right	6 Oct. '72	2	428.1	300	988.4	66.0
(a)Ken. Av. Right	6 Oct. '72	3	506.0	320	893.4	93.6
Ken. Av. Right	6 Oct. '72	4	70.1	150	285.3	205.6
Ken. Av. Right	6 Oct. 72	5	34.1	50	885.3	121.9
Ken. Av. Right	6 Oct. '72	6	40.4	50	730.2	403.9
I-495	17 Oct. '72	1	251.4	300	316.9	165.5
I-495	17 Oct. '72.	2	179.1	200	540.2	185.7
I-495	17 Oct. '72	3	101.8	120	928.6	132.0
I-495	18 Oct. '72	1	169.2	250	141.6	234.0
I-495	18 Oct. '72	2	130.8	250	132.7	175.9
I-495	18 Oct. '72	3	169.6	300	94.4	225.0
I-495	23 Oct. '72	1	435.3	495	332.2	208.1
I-495	23 Oct. '72	2	529.3	565	60.3	254.7
I-495	23 Oct. '72	3	335.2	375	177.0	426.2

(a)A spill of sand, proabably from a passing truck, was noted on Sections 2 and 3 of Kenilworth Avenue on 6 October 1972.

TABLE J-2. BLOW-IN EXPERIMENT DUST AND DIRT - PART 1

Location	Date	Section (#)	Dry Weight (g)	Dry Volume (ml)	Volatile Solids (mg/g)	COD (mg/g)	Grease (mg/g)
Ken. Av. Right	5 Oct. '72	1	125.2	80	656.4	94.9	10.8
Ken. Av. Right	5 Oct. '72	2	113.2	90	975.3	91.5	10.9
Ken. Av. Right	5 Oct. '72	3	226.5	160	784.1	62.5	8.2
Ken. Av. Right	5 Oct. '72	4	137.2	125	946.6	138.9	12.7
Ken. Av. Right	5 Oct. '72	5	114.9	90	123.8	103.5	11.7
Ken. Av. Right	5 Oct. '72	6	154.1	120	70.2	105.4	9.0
Ken. Av. Right	6 Oct. '72	1	95.0	75	186.4	115.4	8.8
(a)Ken. Av. Right	6 Oct. '72	2	249.2	180	58.9	66.6	11.3
(a)Ken. Av. Right	6 Oct. '72	3	238.4	180	53.2	75.5	6.5
Ken. Av. Right	6 Oct. '72	4	167.9	125	108.2	132.9	11.8
Ken. Av. Right	6 Oct. '72	5	89.0	65	270.3	69.9	11.5
Ken. Av. Right	6 Oct. '72	6	104.4	75	188.3	95.4	9.6
I-495	17 Oct. '72	1	2915.4	1905	54.8	78.8	7.2
I-495	17 Oct. '72	2	1556.3	980	49.2	71.9	6.7
I-495	17 Oct. '72	3	1160.1	810	57.8	86.0	7.8
I-495	18 Oct. '72	1	1933.1	1370	40.8	53.6	4.5
I-495	18 Oct. '72	2	2098.0	1350	38.8	54.2	5.6
I-495	18 Oct. '72	3	1762.8	1310	47.3	62.9	7.3
I-495	23 Oct. '72	1	4356.6	2770	84.7	49.9	5.0
I-495	23 Oct. '72	2	5351.1	3455	59.9	56.9	5.8
I-495	23 Oct. '72	3	5289.9	2795	80.3	55.8	6.5

(a)A spill of sand, probably from a passing truck, was noted on Sections 2 and 3 of Kenilworth Avenue on 6 October 1972.

TABLE J-2 (CONTINUED). BLOW-IN EXPERIMENT
DUST AND DIRT - PART 2

Location	Date	Section (#)	Total PO_4-P (mg/g)	NO_3-N (ug/g)	Kjeld. N (mg/g)	Petro. (mg/g)	n-Par. (mg/g)	Asbestos (fbrs/g) x10^{-5}
Ken. Av. Right	5 Oct. '72	1	0.366	32.2	0.71	6.4	5.6	1.9
Ken. Av. Right	5 Oct. '72	2	0.207	36.5	0.28	5.6	5.1	0.6
Ken. Av. Right	5 Oct. '72	3	0.293	33.4	0.59	4.9	3.8	0.0
Ken. Av. Right	5 Oct. '72	4	0.329	29.4	0.79	7.7	5.9	0.6
Ken. Av. Right	5 Oct. '72	5	0.268	28.0	1.09	7.8	4.9	1.3
Ken. Av. Right	5 Oct. '72	6	0.390	23.1	0.60	5.8	3.4	0.0
Ken. Av. Right	6 Oct. '72	1	0.287	38.9	0.80	5.6	4.6	1.3
(a)Ken. Av. Right	6 Oct. '72	2	0.414	33.1	0.77	8.0	7.2	0.0
(a)Ken. Av. Right	6 Oct. '72	3	0.281	28.0	0.55	3.7	3.0	1.3
Ken. Av. Right	6 Oct. '72	4	0.259	37.8	1.03	8.2	7.1	0.0

(a)A spill of sand, probably from a passing truck, was noted on Sections 2 and 3 of Kenilworth Avenue on 6 October 1972.

TABLE J-2 (CONTINUED). BLOW-IN EXPERIMENT
DUST AND DIRT - PART 2

Location	Date	Section (#)	Total PO_4-P (mg/g)	NO_3-N (ug/g)	Kjeld. N (mg/g)	Petro. (mg/g)	n-Par. (mg/g)	Asbestos (fbrs/g) $x10^{-5}$
Ken. Av. Right	6 Oct. '72	5	0.305	26.8	0.81	7.7	6.3	2.3
Ken. Av. Right	6 Oct. '72	6	0.250	32.8	0.87	6.8	5.4	0.0
I-495	17 Oct. '72	1	0.342	19.8	0.36	3.5	2.8	1.8
I-495	17 Oct. '72	2	0.371	21.3	0.44	4.0	3.6	2.6
I-495	17 Oct. '72	3	0.342	19.3	0.41	4.9	2.3	3.2
I-495	18 Oct. '72	1	0.217	16.4	0.28	3.0	2.1	9.6
I-495	18 Oct. '72	2	0.244	21.0	0.29	3.0	2.3	7.6
I-495	18 Oct. '72	3	0.281	15.5	0.31	4.0	3.4	4.4
I-495	23 Oct. '72	1	0.244	17.6	0.17	2.6	2.3	2.6
I-495	23 Oct. '72	2	0.229	14.9	0.20	2.7	2.4	6.4
I-495	23 Oct. '72	3	0.256	13.7	0.25	3.1	1.8	7.7

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/2-75-004	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE CONTRIBUTIONS OF URBAN ROADWAY USAGE TO WATER POLLUTION		5. REPORT DATE March 1975; Approval Date
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Donald G. Shaheen		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Biospherics Incorporated, 4928 Wyaconda Road, Rockville, Maryland 20852		10. PROGRAM ELEMENT NO. 1BB034 Roap/Task 21 ASY 05
		11. CONTRACT/GRANT NO. 68-01-0197
12. SPONSORING AGENCY NAME AND ADDRESS OFFICE OF RESEARCH AND DEVELOPMENT, U.S. ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - 4/72 - 9/74
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT Street surface contaminants are deposited on roadways from many sources within an urban area. Industrial operations, land use activities, fallout of air pollutants, roadway usage and other activities contribute to the loading of particulates on urban roadways. These materials are then carried into receiving waters by storm runoff where they constitute a substantial portion of the overall water pollution problems of cities. Metropolitan Washington, D.C., with its low background of industrial emissions, was the area chosen for study of contributions of motor vehicle usage to urban roadway loading factors. Specific roadway study sites within this area were selected so as to provide minimal interference from nontraffic-related land use activities and thus isolate, as much as possible, the traffic-related depositions.

Motor vehicular traffic is directly or indirectly responsible for deposition of substantial quantities of materials on roadways in urban areas. Significant levels of toxic heavy metals and asbestos and slowly biodegradable petroleum products and rubber are deposited directly from motor vehicles along with large quantities of particulate materials contributed indirectly by traffic. The particulates contributed indirectly by traffic are largely inorganic, but have associated with them solids and nutrients which represent a serious source of water pollutants in all metropolitan areas.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Storm Runoff, Surface Runoff, Traffic-Related Urban Runoff, Pollution (Water), Nutrients, Solids, Heavy Metals, Asbestos, Rubber, Grease	Traffic-Related Street Surface Contaminants	

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